quantizing the blanking data, the subtitle data and the key data;

storing the quantization data;

consolidating levels of said subtitle data and said key data in accordance with quantization data and outputting same;

receiving color data associated with said subtitle data and quantizing it in accordance with stored color quantization data; alternately providing the output signals of said quantizing of blanking data, the subtitle data and the key data and said quantization of color data for conversion into a differential pulse code modulated signal;

converting said differential pulse code modulated signal into a data pair comprising level data and run data;

encoding said run data in accordance with stored variable length encoding data; and

combining said encoded run data with said level data and outputting same.

10. A method for processing in accordance with claim **9**, wherein the step of combining further comprises the step of:

multiplexing for adding time code data and position data to said subtitle data.

11. A method of decoding an encoded video subtitle, comprising the steps of comprising:

receiving an input signal comprised of subtitle data, video data and audio data;

converting the subtitle data into a subtitle output signal;

converting the video data into a video output signal;

converting the audio data into an audio output signal;

wherein said input signal is generated by the steps of:

separating said subtitle data, said video data and said audio data;

distributing said subtitle data, said video data and said audio data for subtitle data decoding, video data decoding and audio data decoding, respectively; and

combining said subtitle output signal and said video output signal and outputting a composite signal of a predetermined format in accordance therewith.

* * * * *

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FIG. 6

Addr	Y	Cr	Cb	K
0	00	7F	7F	00
1	00	7F	7F	20
2	00	7F	7F	40
• • •				
6	00	7F	7F	C0
7	00	7F	7F	E0*
8	00	7F	7F	E0
9	20	7F	7F	E0
• • •				
E	C0	7F	7F	E0
F	E0	7F	7F	E0

* E0 : SUBTITLE DATA 100%
: VIDEO DATA 0%

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FIG. 7A

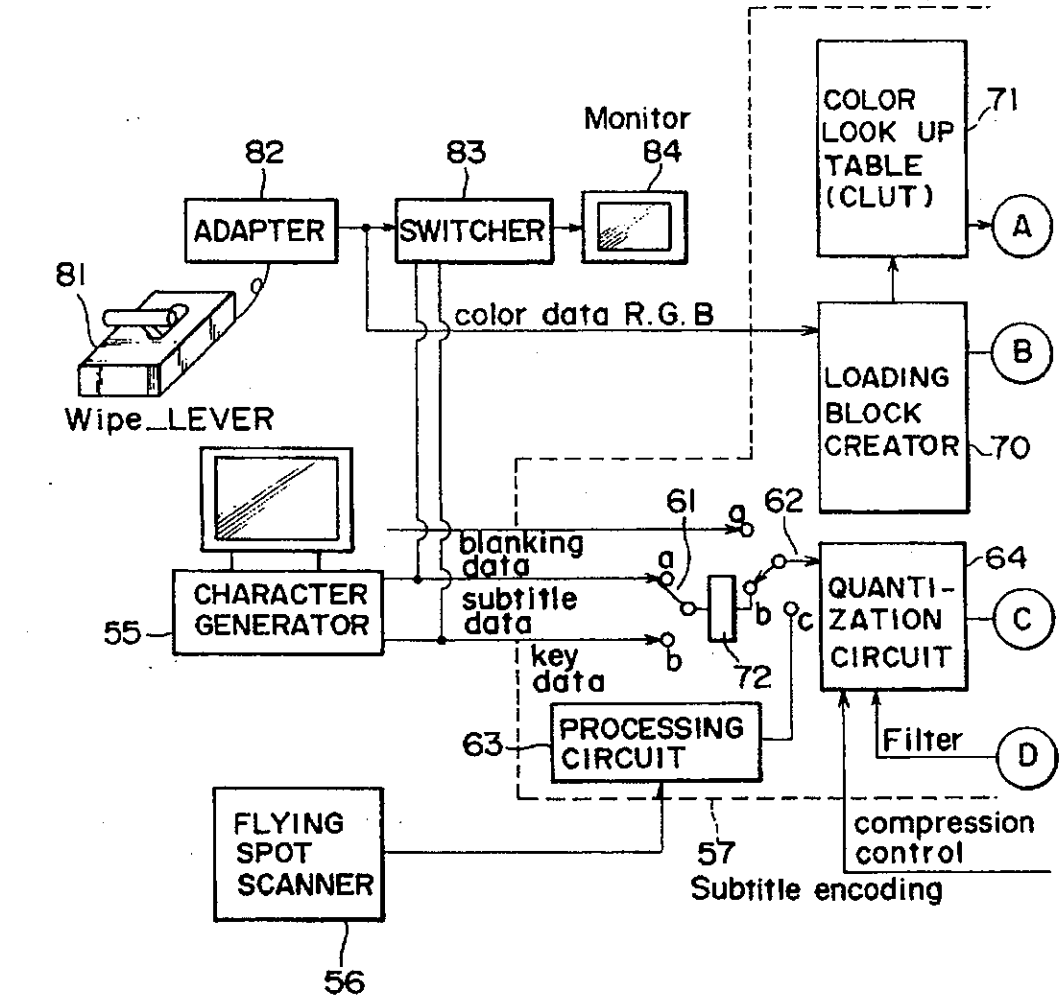

FIG. 7

FIG. 7A	FIG. 7B

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FIG. 7B

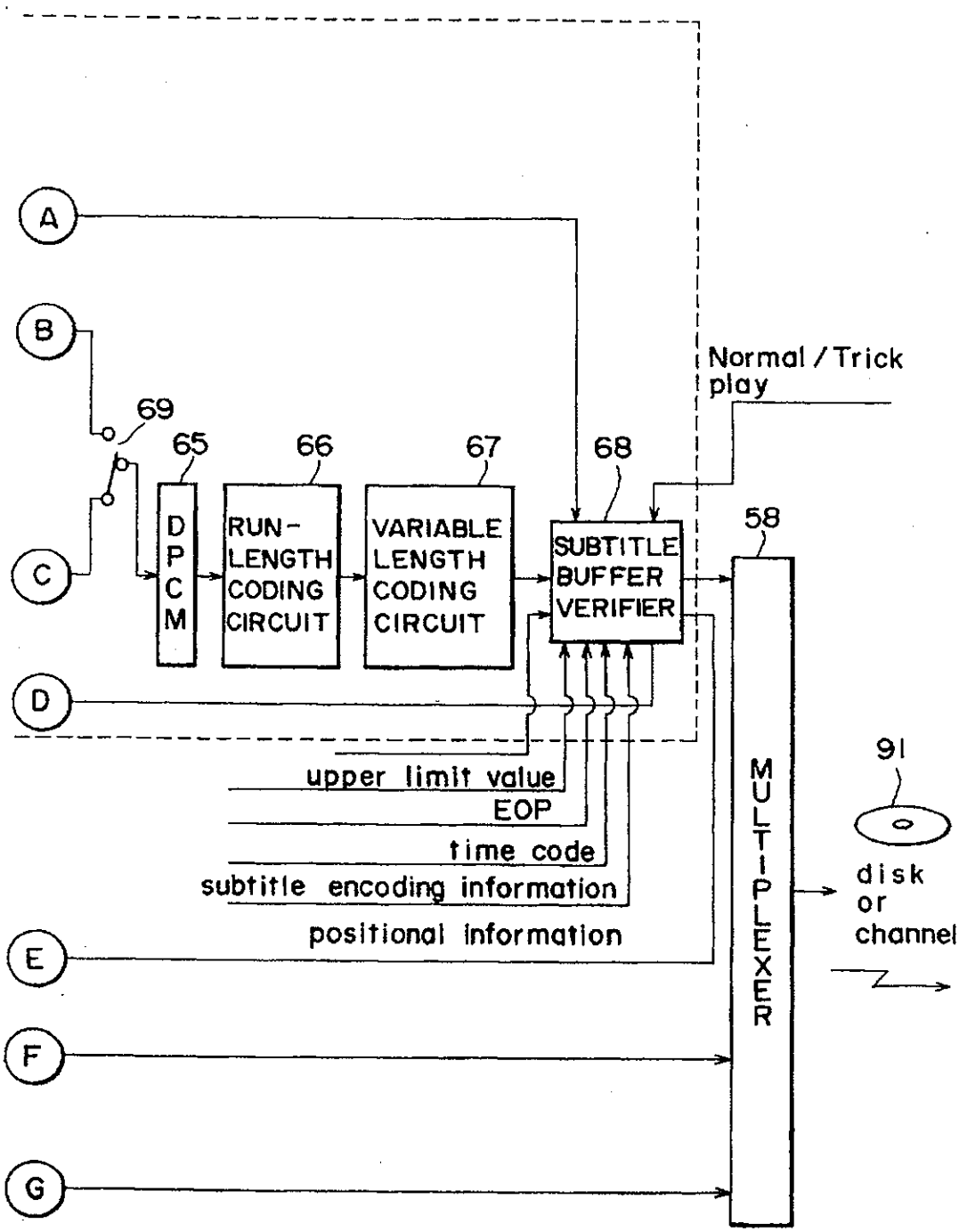

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FIG. 9

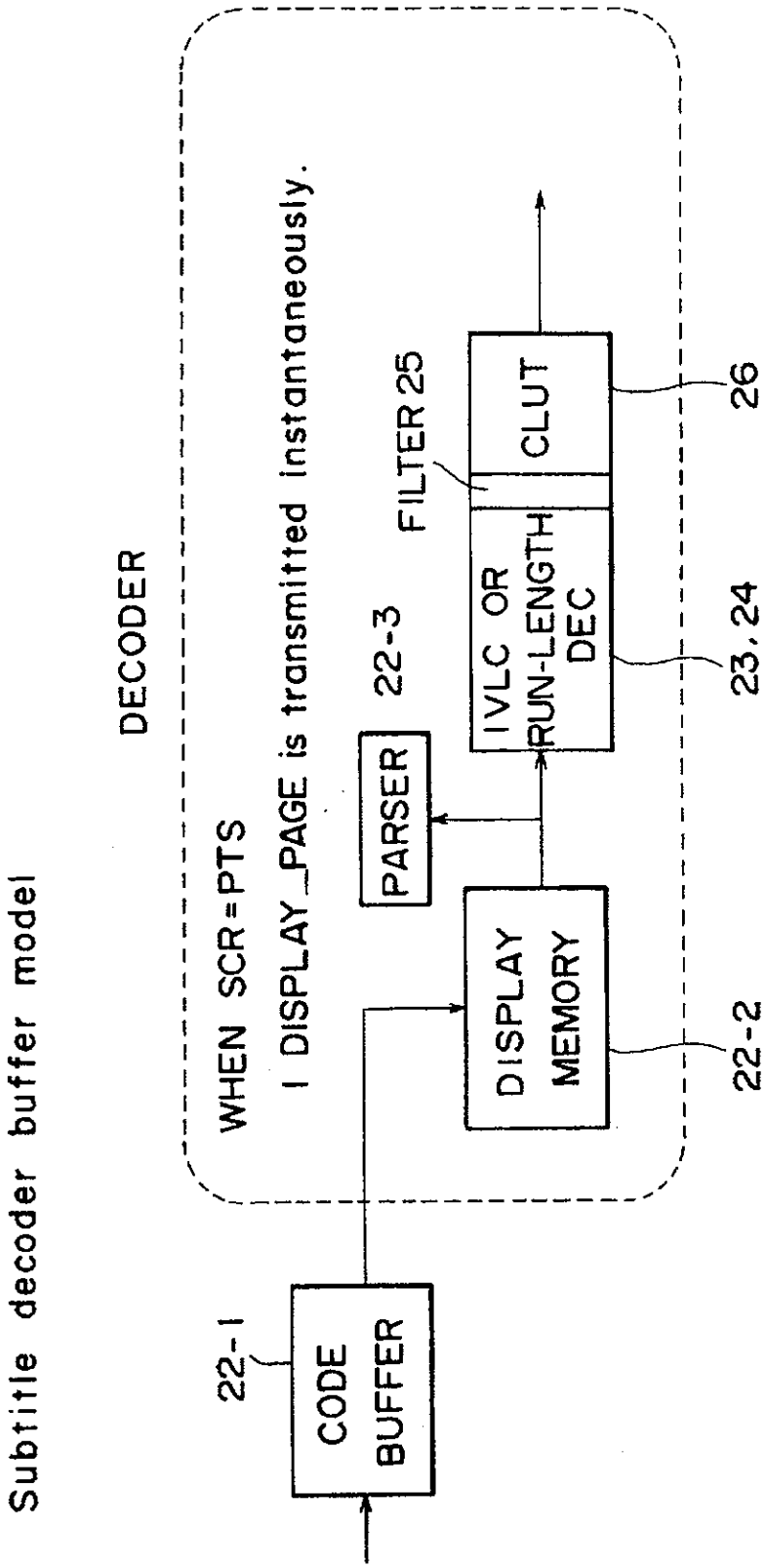

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FIG. 10

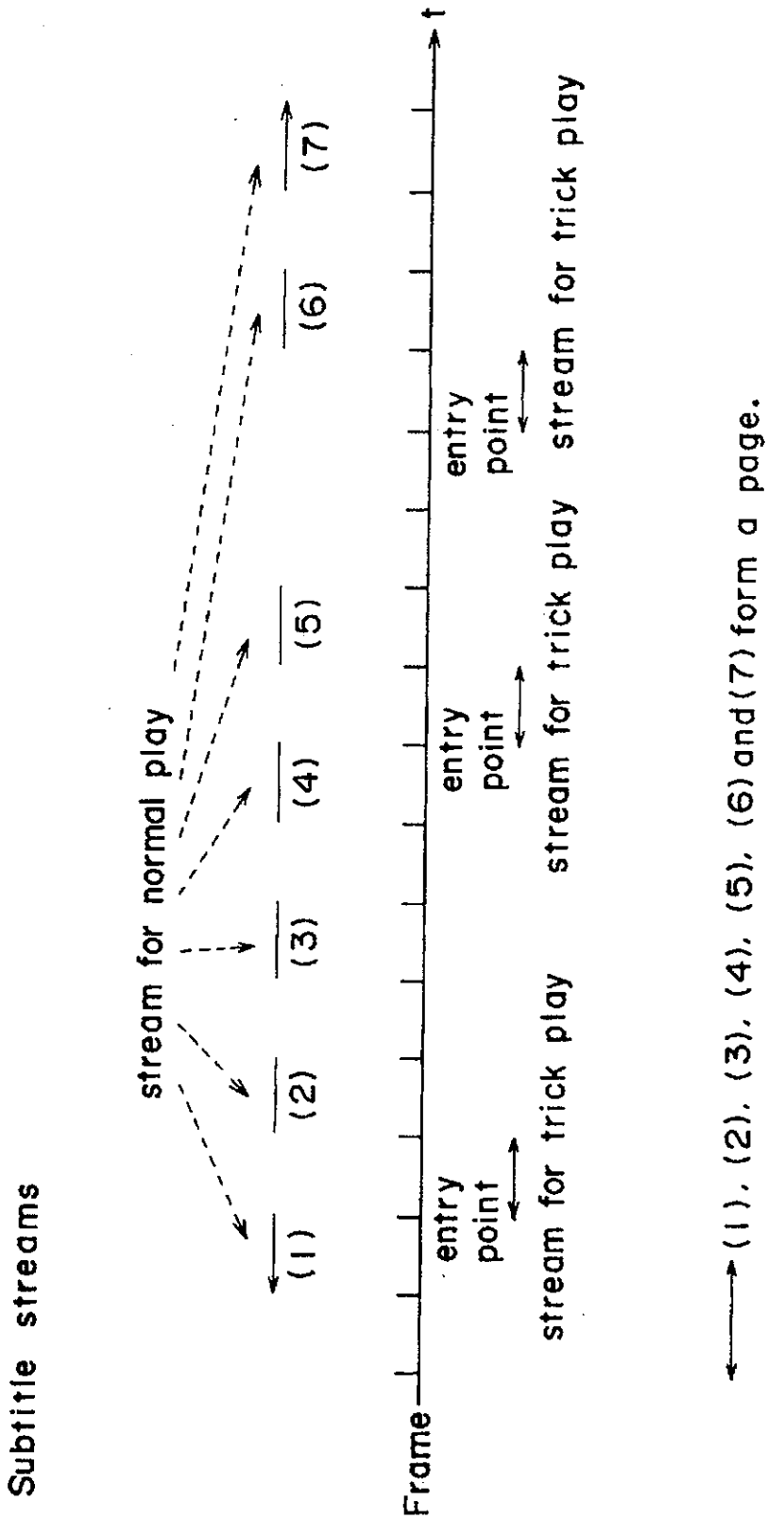

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FIG. 11

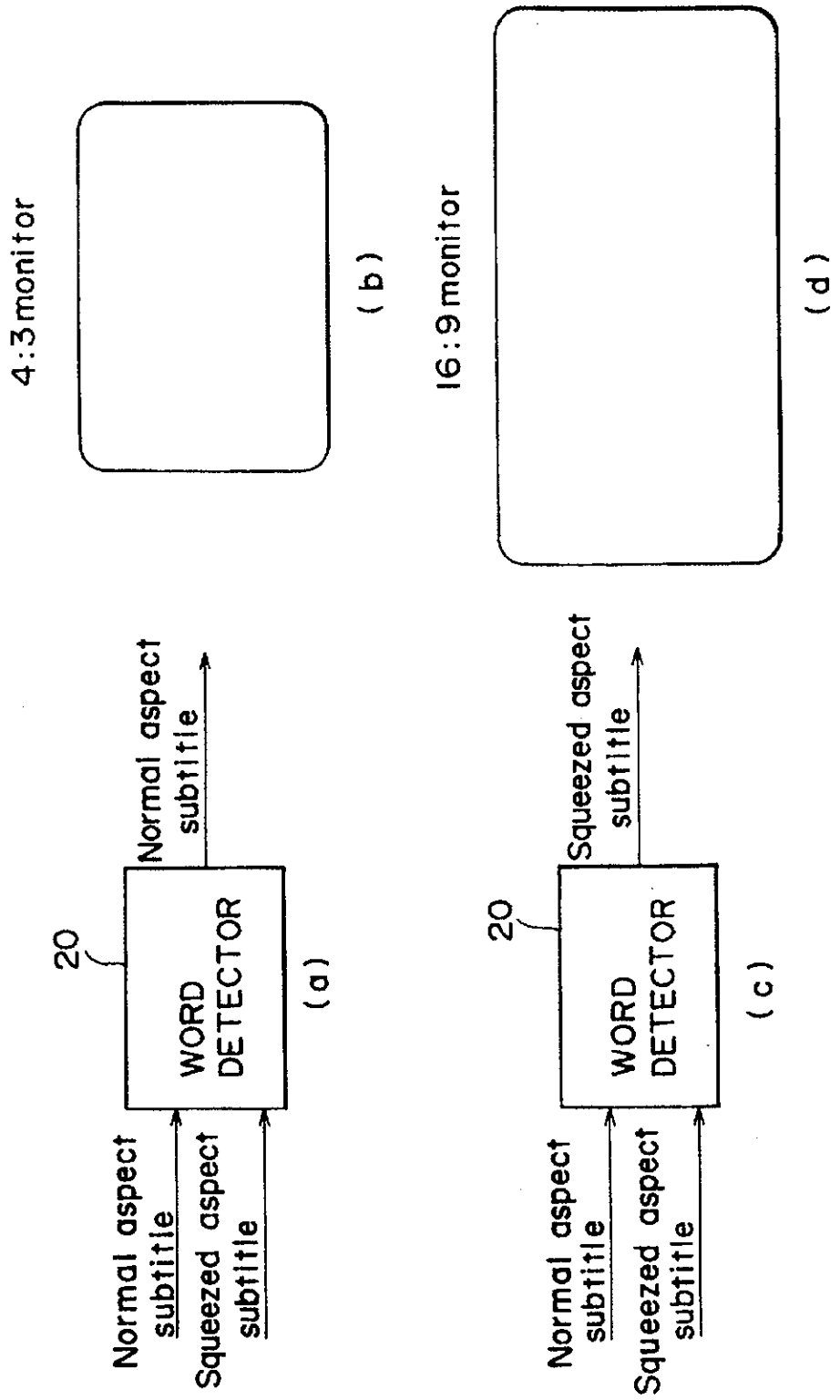

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FIG. 12

Color Lookup table

Addr	Y	Cr	Cb	K
0	00	7F	7F	00
1	20	7F	7F	40
2	40	7F	7F	80
3	60	7F	7F	C0
4	80	7F	7F	F0
5	A0	7F	7F	F0
6	C0	7F	7F	F0
7	E0	7F	7F	F0
8	00	FF	FF	00
9	20	FF	FF	40
A	40	FF	FF	80
B	60	FF	FF	C0
C	80	FF	FF	F0
D	A0	FF	FF	F0
E	C0	FF	FF	F0
F	E0	FF	FF	F0

FIG. 13a

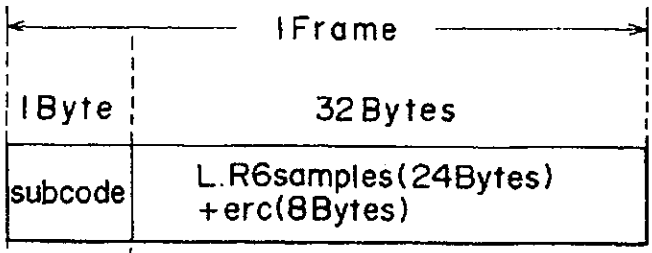


FIG. 13b

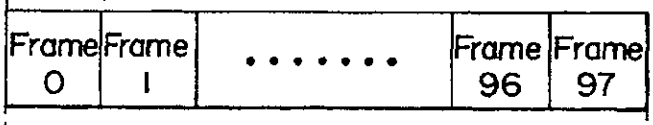
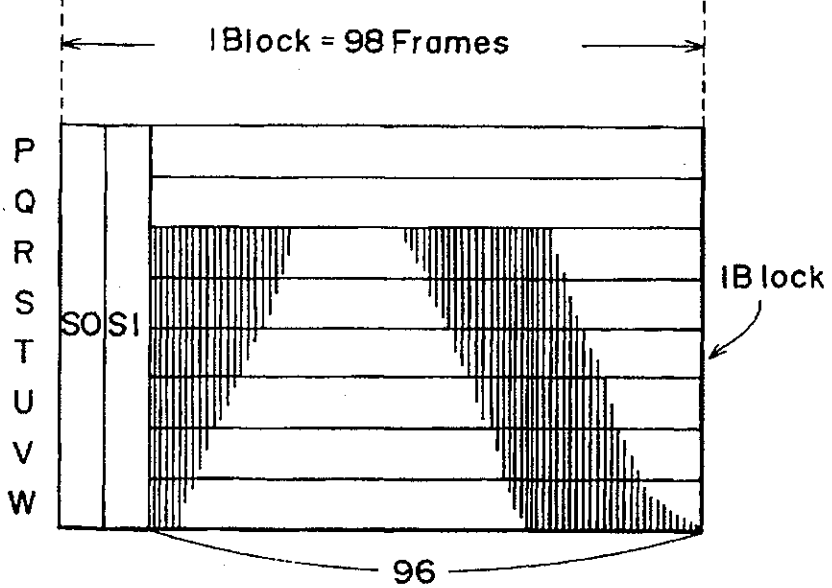


FIG. 13c



1Block → 75Hz

1Frame → 75 x 98Hz

subcode bit rate = 7.35kBytes/s

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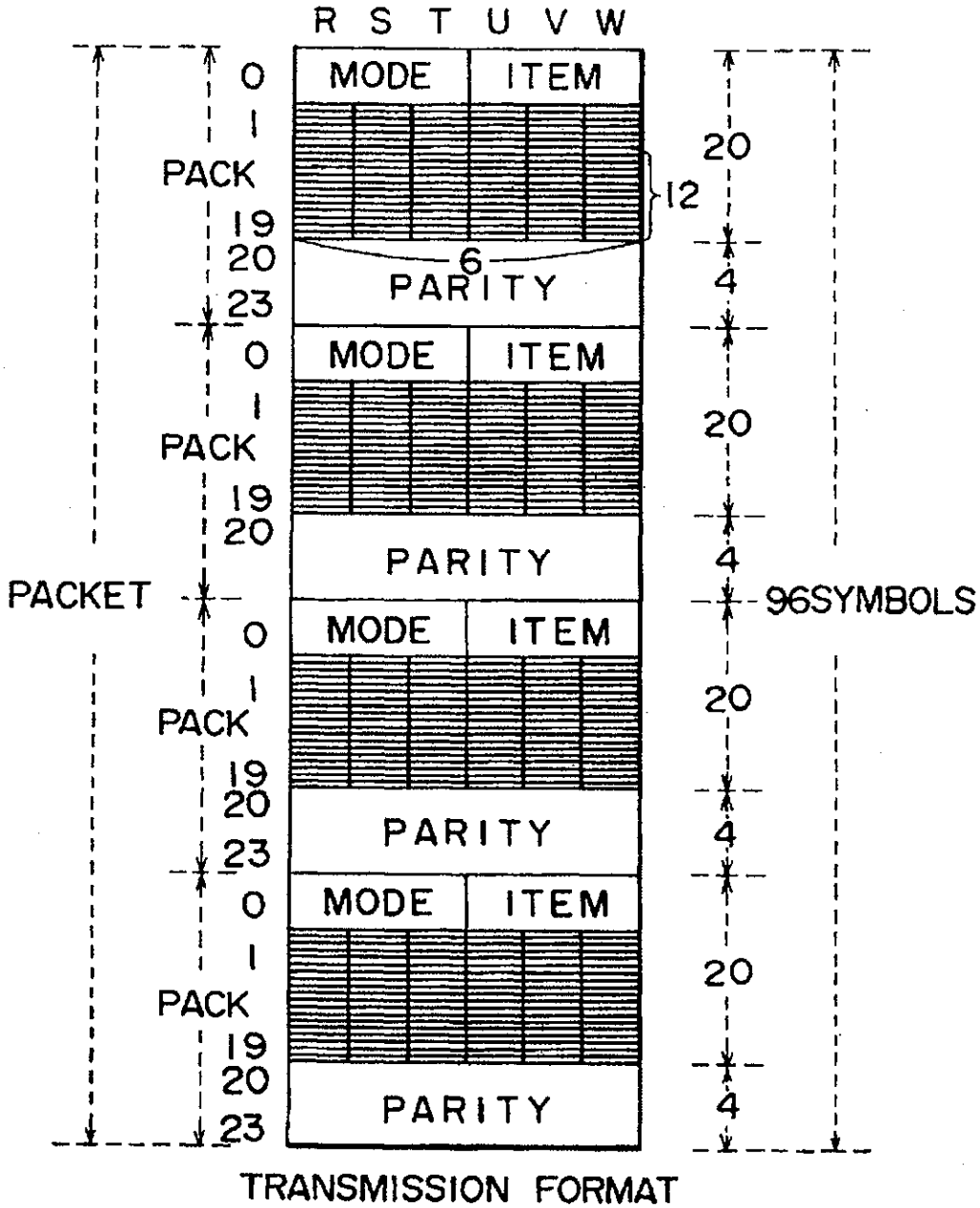
FIG. 14



TRANSMISSION FORMAT

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SUBTITLE ENCODING/DECODING METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to encoding and decoding video data and, more particularly, to encoding and decoding subtitles superimposed on a video display screen.

In video broadcasting, subtitles are employed to convey textual information to the viewer. The subtitles accompany an audio/video broadcast and provide supplemental information to the viewer that may not be perceivable from the broadcast. Subtitles are frequently used, for example, to aid hearing impaired viewers by displaying the spoken language recorded in the audio soundtrack as written language. Another example, is where subtitles are displayed in different languages than the spoken language recorded in the audio soundtrack. In addition, subtitles may be employed to convey important information not related to the subject matter of the corresponding audio/video broadcast. In this case, subtitles may represent late-breaking news, such as: emergency information; sports scores; weather reports; and other important information.

In television broadcasting or video reproduction (such as from a video disk), the subtitles are previously superimposed on the broadcast and become an inseparable part of the video picture. In this situation, a viewer does not have control to turn the subtitles on or off. This is disadvantageous where a viewer desires to video record the broadcast without the subtitles. For example, the viewer may be recording a televised movie and, suddenly, news subtitles are superimposed on the broadcast thereby ruining the recording.

Previously superimposed subtitles are also undesirable because a plurality of languages cannot be selected. Where a viewer does not comprehend the subtitle language the subtitles are annoying surplusage. On the other hand, Where the viewer further does not comprehend the spoken language, the broadcast is incomprehensible to the viewer.

Compact Disc Graphics (CD-G) provide more flexibility in displaying subtitles because this technique records graphics on a compact disc (CD) by using subcodes. However, CD-G has a serious disadvantage because this technique is limited to CD applications. The CD-G technique does not lend itself to other recording formats and, thus, to the vast majority of audio/video broadcasts which employ such other recording formats, such as video tape.

FIGS. 13*a–c* and 14 demonstrate that the CD-G technique is not suitable for use with broadcasting subtitles during real-time broadcasts. In particular, an analysis of the data format employed by CD-G reveals that this technique requires a transmission lead-time of several seconds (10.24 s) which generally is unacceptable for most real-time broadcasts.

FIG. 13*a* depicts the CD-G data format in which one frame includes 1 byte of a subcode and 32 bytes of audio channel data. Of the 32 bytes, 24 bytes are allocated for L and R audio channel data (each channel having 6 samples with 2 bytes per sample) and 8 bytes are allocated to an error correction code. The frames are grouped as a block of 98 frames (Frame **0**, Frame **1**, . . . , Frame **96** and Frame **97**) as shown in FIG. 13*b*. Eight blocks P,Q,R,S,T,U,V and W are transmitted as shown in FIG. 13*c*. The subcodes for Frames **0** and **1** in each block are defined as sync patterns S0, S1, whereas the remaining 96 frames store various subcode data. Among a group of 8 blocks, the first 2 blocks P, Q are allocated to search data employed for searching through record tracks; and graphic data can be allocated to the subcodes in the remaining 6 blocks R,S,T,U,V and W.

Since each block of 98 frames is transmitted at a repeating frequency of 75 Hz, the data transmission rate for 1 block is (75×98 bytes) 7.35 kHz, or 7.35K bytes/s. The transmission format for transmitting the information present in blocks R,S,T,U,V and W is shown in FIG. 14. Each of the 96 frames (2, 3. . . . 97) of the 6 blocks (R,S,T,U,V and W) **96** is arranged as a packet including 6 channels (R to W) of 96 symbols per channel. The packet is further subdivided into 4 packs of 24 symbols each (symbol **0** to symbol **23**), with each symbol representing a frame.

A CD-G character is made up of 6×12 pixels. Since each pack is 6×24, a 6×12 character is easily accommodated in each pack. The CD-G format allocates the six channels of (R,S,T,U,V and W) and the 12 symbols **8** to **19** to a character. The remainder of the symbols in each of the packs store information about the character.

Mode information is stored in the first 3 channels (R, S, T) of symbol **0** in each pack, and item information is stored in the last 3 channels (U, V, W) of symbol **0**. A combination of the mode information and the item information defines the mode for the characters stored in the corresponding pack as follows:

TABLE 1

Mode	Item	
000	000	mode
001	000	graphics mode
001	001	TV-graphics mode
111	000	user's mode

An instruction is stored in all of the channels of symbol **1**. Corresponding mode, item, parity or additional information for the instruction is stored in all of the channels of symbols **2** to **7**. Parity for all of the data in the channels of symbols **0** to **19** is stored in all of the channels of the last 4 symbols (symbols **20** to **23**) of each pack.

As discussed, the data is transmitted at a repeating frequency of 75 Hz. Therefore, a packet which contains 4 packs is transmitted at a rate of 300 packs per second (75 Hz×4 packs). That is, with 1 character allocated to the range of 6×12 pixels, 300 characters can be transmitted in 1 second.

However, a CD-G screen requires more than 300 characters. A CD-G screen is defined as 288 horizontal picture elements×192 vertical picture elements and requires more than twice the 300 characters transmitted in 1 second. The total transmission time for a 288×192 screen is, therefore, 2.56 seconds as shown by the following equation:

$$(288/6)\times(192/12)\div 300=2.56 \text{ seconds}$$

This is extremely long to regenerate each screen when it is considered that screens are usually refreshed every 0.6 seconds. This problem is compounded when hexadecimal codes are used for the characters because each hexadecimal expression requires 4 bits to represent 1 pixel. As a result, 4 times the data described above is transmitted increasing the transmission rate to 10.24 seconds (4×2.56 seconds). Since each screen requires a sluggish 10.24 seconds for transmission, a continual transmission of screens means that a lag time of 10.24 seconds is experienced when transmitting screens using the CD-G technique. Thus, the CD-G technique is not performed in real time and is unacceptably slow for use in a real time broadcast.

The CD-G system also suffers from defects in reproducing the subtitles. The CD-G system displays subtitles only

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upon normal reproduction and not during special reproduction such as a fast forward or fast reverse reproduction. CD-G pictures are also subject to sing phenomena (in which oblique portions of a character are ragged) or flickering because this system allocates only one bit of data for each picture element. The lag time of the CD-G picture also prevents switching the subtitle display on or off at a high speed.

In one type of system (known as the CAPTAIN system), dot patterns, as well as character codes, represent the subtitles. This system, however, does not appear to be any better than the CD-G system and suffers from some of the same disadvantages. In both systems, for example, the subtitles lack refinement because these systems do not provide sufficient resolution power in displaying the subtitles. The CAPTAIN system, for example, is developed for a 248 (horizontal picture elements) by 192 (vertical picture elements) display and not for high resolution video pictures of 720×480.

OBJECTS OF THE INVENTION

An object of the invention, therefore, is to provide an encoding/decoding method and apparatus for encoding and decoding subtitles with a greater degree of flexibility.

A further object of the invention is to encode the subtitles separately from the video data so that the subtitles may be independently manipulated.

A further object of the invention is to decode the subtitles in real time so that the subtitles may be contemporaneously superimposed with a video picture.

An even further object of the invention is to provide a processor for controlling the encoding/decoding of the subtitles for controlling a flow rate of subtitle data read out from a buffer such that the subtitle data is contemporaneously combined with corresponding video data.

SUMMARY OF THE INVENTION

The encoding apparatus of the present invention provides a subtitle generator for generating the subtitles for display with a respective video picture. The subtitles are encoded into encoded subtitle data and the flow rate of the data is regulated by a buffer to be contemporaneous with the respective video picture encoded by a video encoder.

In the decoding apparatus of the present invention a buffer regulates the flow rate, i.e. the rate at which bits are read from the buffer, of the encoded subtitle data to contemporaneously combine the encoded subtitle data with a respective video picture decoded by a video decoder. The encoded subtitle data is decoded into decoded subtitle data and a mixer superimposes the decoded subtitle data and the respective video picture.

The invention also provides a processor for controlling the encoding/decoding. A respective one of several bit streams of subtitle data is selectively buffered; and a time display stamp indicates the time when the respective bit stream is to be decoded. Decoding of the respective bit stream is initiated during the time indicated by the time display stamp. A mixer mixes the respective decoded bit stream with video picture data.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention and many of its attendant advantages will be readily obtained by reference to the following detailed description considered in connection with the accompanying drawings, in which:

FIG. **1** is a block diagram of a data decoding apparatus of the present invention;

FIG. **2** is a block diagram of the subtitle decoder depicted in FIG. **1**;

FIG. **3** is a table of communications between the system controller of FIG. **1** and the controller of FIG. **2**;

FIG. **4** is a table of parameters for the communications between components of FIG. **1** and FIG. **2**;

FIGS. **5***a* to **5***c* are signal diagrams demonstrating data encoding of the present invention;

FIG. **6** is a color look up table referred to when encoding subtitle data;

FIGS. **7**, **7***a* and **7***b* constitute a block diagram of the encoding apparatus of the present invention;

FIG. **8** is a graph for the explanation of a code buffer operation;

FIG. **9** is a block diagram describing the internal operation of the code buffer in FIG. **2**;

FIG. **10** is an explanatory depiction of streams of subtitle data;

FIGS. **11***a–d* depict the relationship between video and subtitle data relative to an aspect ratio of a monitor;

FIG. **12** is a color look up table referred to when conducting a color wipe operation;

FIGS. **13***a* to **13***c* depict the arrangement of data according to a CD-G format; and

FIG. **14** depicts a transmission format of the data in the CD-G format.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout, the present invention will be described.

Decoding Apparatus

The data decoding apparatus which incorporates the present invention is shown in FIG. **1** and decodes a reproduction signal to generate a video picture superimposed with subtitles. The system controller **14** of the data decoding apparatus causes the reproduction signal to be processed and sent to a subtitle decoder **7**. The system controller communicates with the controller **35** (FIG. **2**) of the subtitle decoder to decode the subtitles and combine the decoded subtitles with decoded video data. The combined subtitle and video data are, then, prepared for display on a television screen.

A data decoder and demultiplexer **1** receives a digital reproduction signal from, for example, a VCR. The data decoder and demultiplexer **1** error decodes the reproduction signal preferably employing an Error Correcting Code (ECC) technique and demultiplexes the error decoded reproduction signal into video, subtitle and audio data. A memory **2** may be used, for example, as a buffer memory and a work area for the purpose of error decoding and demultiplexing the reproduction signal.

A video decoder **3** decodes the demultiplexed video data from a video data stream. A memory **4** may be employed for the operation of decoding the video data similar to the operation of the memory **2** employed with data decoder and demultiplexer **1**.

A letter box circuit **5** converts a video picture with a 4:3 aspect ratio (a squeeze mode) to a 16:9 letter box ratio. The conversion is performed using a 4 to 3 decimation process,

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whereby every four horizontal lines are decimated to three horizontal lines, thus squeezing the video picture into a ¾ picture. According to the letter box format, a vertical resolution component is derived from the remaining ¼ of the video picture which is employed to enhance the vertical resolution of the decimated video picture. A timing control memory **6** ensures that the ¼ of the letter box picture is not transmitted. When the decoded video data generated by the video decoder **3** is already in a 16:9 letter box format, the letter box circuit bypasses the decimation operation and sends the decoded video data directly to the subtitle decoder **7**.

Meanwhile, the decoded subtitle data demultiplexed by the data decoder and demultiplexer **1** is directly sent to the subtitle decoder **7**. The subtitle decoder **7** decodes the subtitle data according to instructions from the system controller **14** and mixes the decoded subtitle data with the decoded video data.

A composite encoder **8** encodes the mixed subtitle data and video data into a suitable video picture format, such as NTSC/PAL. A mode display **9** interfaces with a user and indicates, for example, the mode of television monitor connected thereto. A D/A converter **10** converts the encoded signal received from the composite encoder **8** into an analog signal suitable for display in the indicated mode, such as NTSC or PAL.

The audio portion of the audio/video signal decoded by the data decoder and demultiplexer **1** is decoded by an audio decoder **11** which decodes the demultiplexed audio data using a memory **12**, for example. The decoded audio data output from the audio decoder is converted into an analog audio signal appropriate for broadcast through a television monitor by a D/A converter **13**.

Subtitle Decoder

The subtitle decoder **7** of FIG. **1** communicates with the system controller **14** through a controller **35** as shown in FIG. **2**. This communication controls the subtitle decoding performed by the subtitle decoder. Definitions of the communication signals between the system controller **14** and the controller **35** will be discussed with reference to FIG. **3**.

The system controller **14** sends a reset command to the controller **35** to reset the subtitle decoder **7** and sends command signals indicating an operation mode of the subtitle decoder to initialize it. A special command is sent to the controller **35**, for example, when a user indicates through the mode display **9** (FIG. **1**) that special reproduction, such as a fast-forward or fast-reverse reproduction, is to be commenced. The user may also turn the subtitles on or off through the mode display, causing the system controller to issue a display ON/OFF command to the subtitle decoder. The user may also control the subtitle display position in the vertical direction relative to the video picture on the television monitor, causing the system controller to issue an U_position value to the subtitle decoder. With these initial parameters defined for the subtitle decoder, a decoding operation now will be described.

The subtitle data is grouped into streams of data comprising bits. Each bit stream corresponds to a portion of a page making up the entire subtitle picture for one picture frame. As shown in FIG. **2**, the bit streams are applied to a word detector **20**. Since the word detector selects which bits to forward to the code buffer **22**, different types of bit streams may be applied to the word detector contemporaneously. In the preferred invention, for example, bit streams of both a normal playback mode and a fast-forward, or a fast-reverse, mode (special reproduction) are applied to the word detector.

Indeed, several broadcasts of video pictures can be applied to the word detector simultaneously. To that end, different channels are provided for different video pictures. The word detector **20** selects the channel indicated by a channel_select signal sent from the system controller **14** and receives the appropriate bit streams.

The system controller **14** also issues a stream_select signal to instruct the word detector **20** to select either the normal playback mode bit streams or the special reproduction mode bit streams. Thus, a viewer can switch between a normal playback mode and a special reproduction mode without delay.

The word detector **20** is also responsible for detecting both header and header_error information received in the selected bit streams. The header and header_error information are sent as information signals, S. header and header error, to the system controller **14** (via the controller **35**) for further processing. Similarly, error data representing a detected error is sent as a data error signal to the system controller **14** when the word detector detects errors in the bit stream subtitle data. If the data cannot be restored, a buffer clear signal is sent from the system controller to the controller and the erroneous subtitle data is dumped.

A scheduler **21** is provided to ensure that the data received from the demultiplexer **1** (FIG. **1**) does not overflow the code buffer **22**. The scheduler controls read/write access to the code buffer by determining a bandwidth for an I/O port (not shown) which receives the bit streams selected by the word detector. The bandwidth refers to the number of parallel bits supplied to the I/O port at one time and is calculated by dividing the rate at which the demultiplexer demultiplexes data by the rate at which data is read from the code buffer. For example, a data rate from the demultiplexer of 20 Mbps divided by a 2.5 Mbps rate of data read from the code buffer is equal to 8 bits. Therefore, the scheduler will set the I/O port to receive 8 bits in parallel in order to maintain a consistent flow rate of data into and out of the code buffer.

A read operation is commenced in real time and is triggered when the code buffer receives a decode start command from the system controller **14**. The timing for the reading is determined from horizontal and vertical sync signals stored in the headers of the subtitle data detected by the word detector **20**. For real time display, the reading rate should correspond to a picture element sampling rate, preferably 13.5 MHz. As discussed, the subtitle data preferably is written into the code buffer at a rate of 2.5 MHz or more. Thus, the 13.5 MHz sampling clock is divided into four clock cycles of 3.375 MHz each. One of these 3.375 MHz clock cycles is allocated to writing (because writing requires at least 2.5 MHz) and the remaining three clock cycles are allocated to reading data from the code buffer thus satisfying the requirement for real time display.

The read/write operation described is performed in real time and provides high resolution. Eight bit of the subtitle data are read from the code buffer **22** for each of three clock cycles, or twenty-four bits per sampling clock. When display of the picture is conducted by the television monitor every fourth clock cycle, one-fourth of the twenty-four bits, (24/4=) 6 bits are displayed at every clock cycle. That is, each subtitle picture element may comprise six bits, which is more than sufficient to achieve a high quality of resolution for the subtitles.

A duration signal and a PTS signal are retrieved by the controller **35** when it is deemed that data will be read from the code buffer. The duration signal indicates the duration

that the subtitle data lasts and the PTS signal indicates the proper time that the subtitle data is to be superimposed with the video data. The controller times the display of the subtitles using an internal system clock reference (SCR). When the subtitles are to be displayed, the system controller **14** sends the display ON command to the controller **35**. The system controller sends the display OFF signal as a subtitle decode termination signal to the controller **35** upon termination of the subtitle display.

The system controller may also initiate a special reproduction operation in the subtitle decoder by sending a special command to the controller **35**. The controller sends back an acknowledge signal (special_ack), acknowledging that special reproduction is to be initiated. To perform a special reproduction operation, the word detector must select bit streams at a special reproduction rate. Moreover, the code buffer will read out bit streams at a special reproduction rate. To uniformly speed up (or slow down) the operations of the subtitle decoder according to the special reproduction rate, the system clock reference (SCR) can be altered by adding or subtracting clock pulses. Subtraction pulses are created at an n times rate corresponding to the rate of fast-feeding or fast-reverse feeding. At the actual time when special reproduction is commenced, real time subtraction is performed on the bit stream of subtitle data read out from the code buffer at the n times rate. The special reproduction operation may also correspond to a pause operation, wherein no subtraction pulses are created; and instead, an identical frame is continuously read from the code buffer repeatedly.

Decoding of the subtitles also ends when the subtitle decoder **7** determines that an end of page (EOP) of the video picture is reached. In the preferred embodiment, the system controller **14** sends a repeat time signal to the controller **35** which indicates the length of a page. A run-length circuit **24** includes a counter and sends a display end signal to the controller **35** when the count value of the counter reaches the value indicated by the repeat time signal. The controller **35** thus determines that the repeat time is reached and stops reading from the code buffer. For purposes of this invention, the code buffer preferably stores two pages of subtitle data because one page will be read as another page is written into the code buffer.

The controller **35** issues a buffer overflow signal to the system controller **14** when an overflow of the code buffer occurs. An overflow can be determined when the controller receives the display end signal from the run-length circuit **24** before the word detector **20** receives an end of page (EOP) signal on the following page. At that time, the system controller **14** withholds transfer of subtitle data from the data decoder and demultiplexer **1** (FIG. **1**) to the word detector to prevent an overflow of the code buffer. The stream_select signal from the system controller **14** designates the streams of subtitle data and the display start position is updated on every frame. Thus, after an overflow condition has passed, the next stream will be written into the code buffer and displayed at the correct display start position.

FIG. **8** graphically demonstrates the data flow into and out of the code buffer **22**. The t-axis (abscissa) represents time, while the D-axis (ordinate) represents a data size for each page of data. Thus, the gradient (rise/run) represents the data flow rate of the subtitles into the code buffer. Graph (C) represents the data flow of the subtitle data. The vertical portions of graph (C) indicate a transfer of subtitle data from the code buffer when the display time stamp (PTS) is aligned with the synchronizing clock (SCR) generated internally by the subtitle decoder **7**. The horizontal portions of the graph (C) indicate the transfer of subtitle data into the code buffer. For example, at a time that the display time stamp (PTS) for page (S0) is received by the code buffer, the previous page of subtitle data is transferred from the code buffer and page (SO) is written into the code buffer. When another display time stamp (PTS) is received by the code buffer, the subtitle data of page (SO) is transferred out of the code buffer and page (S1) is written in. Similarly, the remaining pages (S2), (S3) are written into and read out of the code buffer as indicated.

An underflow condition exists when the code buffer has completed reading the subtitle data for an entire page and no further data exists in the code buffer. A code buffer with a capacity of two pages is depicted by the "code buffer size" line in the FIG. **8**. Graphically, an underflow would appear in FIG. **8** as one of the vertical portions of line (C) which extends below the lower limit of the code buffer. By contrast, an overflow condition is graphically depicted in FIG. **8** when the subtitle data read into the code buffer is too large, i.e., the horizontal portion of line (C) extends beyond line (B). The code buffer must also perform delay compensation, especially where an external memory is employed, for decoding the video data. The delay compensation is achieved by controlling the timing of the decode start command from the system controller **14**. When the controller **35** of the subtitle decoder **7** sends the display time stamp (PTS) to the system controller upon writing the subtitle data to the code buffer **22**, the system controller, in response, sends the decode start instruction to the controller **35**. The system controller **14** delays the decode start command by a time equal to the processing of a letter box picture (approximately one field) and a delay caused by video decoding at the instant the synchronizing clock of the controller (SCR) is aligned with the display time stamp (PTS). Delay compensation is particularly useful, since the video, audio and subtitle data are multiplexed on the premise that the decode delay in each of the video, audio and subtitle data signals is zero in the data encoding apparatus.

Once the subtitle data is read from the code buffer **22**, an inverse VLC (Variable Length Coding) circuit **23** (FIG. **2**) subjects the subtitle data to variable length decoding. The variable length decoded subtitle data is composed of level data and run data as paired data. In the case were variable length decoding is not employed, the inverse VLC circuit may be bypassed and the subtitle data read from the code buffer will be directly output to the inverse run-length circuit **24**.

The inverse run-length circuit **24** conducts run-length decoding by generating the level of data from the number of run data elements. Thus, the VLC circuit **23** and the run-length circuit **24** decompress the subtitle data which had been stored as compressed data in the code buffer **22**.

The decompressed subtitle data is then sent to a 3:4 filter **25**. The 3:4 filter receives an xsqueeze signal from the system controller **14** indicating the aspect ratio of the corresponding television monitor. Where the signal indicates that the monitor has a 4:3 aspect ratio, the 3:4 filter applies 3:4 filtration processing to the subtitle data to match the size of the subtitles to the size of a (16:9) video picture as shown in FIGS. **11***c, d*. In the preferred embodiment, the controller **35** reads 90 pixels worth of subtitle data from the code buffer **22** before the H sync pulse is generated. In the case where the television monitor already has a 16:9 aspect ratio, or the decompressed subtitle data represents fonts, the 3:4 filter is bypassed as shown in FIGS. **11***a, b*.

A color look-up table **26** (CLUT) (which stores luminance data Y, color difference data (Cr Cb), background video data,

and key data K representing a data mixing ratio for the Y, Cr and Cb color components), receives the subtitle data from the 3:4 filter **25**. FIG. **6** shows an example of a color look-up table where the components Y, Cr, Cb and K are arranged according to the addresses 0 . . . F (hexadecimal). The color look-up table is employed to generate the correct color for each pixel of the subtitle characters. That is, the luminance value Y and the color difference values Cr, Cb for a particular pixel are mixed according to the ratio specified by the key data K. A mixer **34** (FIG. **2**) mixes the pixel from color look-up table **26** with video data from the video decoder **3** (FIG. **1**). The resulting mixed data represents a video picture with superimposed subtitles and is ready to be output to a television monitor.

Background video data is incorporated in the arrangement of the color look-up table. For example, address 0 of the look-up table includes key data K having the value of 00 H; which means that the subtitle data will not be seen and the background video data will manifest, as shown by regions T1 and T5 in FIG. **5***c*. Addresses 1 to 6 of the look-up table include values of the key data K which increase linearly (20, 40 . . . C0 hexadecimal); which means that the subtitle pixels according to these addresses are mixed with the background data as shown by the regions T2 and T4 in FIG. **5***c*. Finally, addresses 8 to F of the look-up table include values of key data K of E0; which means that the components Y, Cr and Cb are mixed without any background video data as shown by region T3 in FIG. **5***c*. The color look-up table data is generated from the system controller and is previously downloaded to the CLUT circuit before decoding. With the color look-up table, the filtered subtitle data is transformed into the appropriate color pixel for display on the television monitor.

Another example of a color look-up table is shown in FIG. **12**. The arrangement of the data and the values according to the components in this table may be used to provide color wiping. Color wiping is a display technique which "overlaps" previously displayed elements, such as subtitles, with another color usually by performing the overlay from left to right progression.

With the present invention, a viewer has control over the display of the subtitle through the mode display **9**. The system controller **14**, upon command from the user, sends a control signal to the mixer **34** (FIG. **2**), turning the subtitles on or off. Since the present invention generates subtitles in real time, the user does not experience any unpleasant delay when turning the subtitles on or off. In addition, the subtitles can be controlled, by the user or otherwise, to fade-in/fade out at a variable rate. This is achieved by multiplying a fade coefficient to the pattern data representing the subtitles at a designated speed. This function also allows an editor of the subtitles to present viewers with different sensations according to the broadcast audio/video picture. For example, news information may be "flashed" rapidly to draw attention to the viewer, whereas subtitles in a movie might "softly" appear in order not to detract from the enjoyment of the movie.

The mixer **34** is also operable for positioning the subtitles within the video picture. This is achieved by a u_position signal sent from the system controller **14** to the mixer via controller **35** which designates the vertical direction for display on the screen. It will be noticed that the u_position value may be varied, either by a user or otherwise. This provides additional control over the position of the subtitles and a user is free to place the subtitles anywhere along a vertical axis.

The decoding apparatus of the present invention may be practiced with the parameters for the different signals shown in FIG. **4**. However, the present invention is not limited to the parameters set forth in that figure and may be employed in different video systems.

In overview, the subtitle decoder **7** may be thought of as the subtitle decoder buffer model in FIG. **9**. The code buffer **22-1** accumulates streams of subtitle data until at least one page of subtitle data is accumulated in the code buffer. The subtitle data for one page is transferred from the code buffer **22-1** to the display memory **22-2** (which acts as a buffer for the subtitle decoder) when the display time stamp (PTS) is aligned with the synchronizing clock (SCR). It will be noted that placing the code buffer and display memory in a single unit is preferred since the code buffer need only increment a pointer pointing to the current address in the display memory **22-2** which stores the next set of subtitle data. Thus, no delay is caused due to a transfer, resulting in a high speed transfer of the subtitle data.

Once the subtitle data for one page is transferred to the display memory **22-2**, the subtitles are transferred to the IVLC or run-length decoding section **23**, **24** for decoding. The headers of the bit streams are separated therefrom by a parser **22-3** and forwarded to the inverse variable-length code or run-length decoder **23**,**24** during a vertical blanking period (V). After decoding, the decoded subtitle data is filtered by filter **25** and color adjusted according to the color look-up table circuit **26**. The streams applied to the code buffer **22-1** include subtitles for both normal and special reproduction, such as a fast-forward or fast-reverse mode. The code buffer selectively writes the streams therein according to the stream_select information supplied from the system controller **14** to select either the normal or special reproduction streams as will now be described.

FIG. **10** demonstrates the order of the streams for both normal and special reproduction. The t-axis represents the time in which a frame of subtitle streams are written into the code buffer **22**. A frame includes streams which make up a page during normal play and streams that make up a page for special (or trick) play. Streams (1) through (7), for example, make up one page of subtitle data for normal play. These normal-play streams are written into the code buffer at a time along the t-axis corresponding to an "entry point". When all of the streams (1) through (7) are transferred to the code buffer, the entire page constituted by these streams is output to the display memory. The streams for special play (referred in FIG. **10** as "trick play") are staggered in-between the streams for normal play as shown in the figure. The code buffer selects between the streams of normal and special play depending upon the stream_select signal sent from the system controller **14**.

This arrangement is advantageous because both pages for normal and special reproduction are applied to the code buffer at the same time. That is, the mode of the subtitle decoder **7** can be instantly changed from normal to special reproduction without lapse and the viewer experiences no lapse when subtitles are displayed in a normal mode, then, in a special mode, such as a fast-forward reproduction.

Encoding Technique

The encoding technique employed in the present invention will be described in more particular detail with reference to FIGS. **5***a*, **5***b* and **5***c* and FIG. **6**. As an example, the technique for encoding the letter "A" of FIG. **5***a* will be explained. The letter "A" is scanned along successive horizontal lines and the fill data of FIG. **5***b* is generated for the letter "A" along each horizontal line. It will be noted that the level "E0" demarks the highest level for recreating a color

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pixel from the color look-up table shown in FIG. 6, whereas level "0" represents a lack of subtitle data.

The key data (K) determines the degree to which the fill data is mixed with background video. Regions T1 and T5 of the key data correspond to areas in the video picture that are not superimposed with the fill data; therefore, these areas are designated as level 0 as indicated by address 0 in FIG. 6. Regions T2 and T4 are mixed areas where the subtitles are gradually mixed with the background video picture so that the subtitles blend into the background video picture and do not sharply contrast therewith. Any of the fill data in this area is stored in addresses 1 through 6. The main portion of the letter "A" is displayed within the T3 region where the background information is muted. The subtitle information in region T3 is stored as addresses 7 to F hexadecimal. The color look-up table of FIG. 6 is arranged in varying degrees of the luminance component Y. When a pixel in the region T3 is to be stored, for example, and the level of the luminance component Y for that particular pixel is 20 (hexadecimal), address 9 is stored for that pixel. In this manner, the remaining pixels for the subtitle characters are encoded for transmission.

Encoding Apparatus

The encoding apparatus of the present invention is depicted in FIGS. 7A, B. Audio and video information is received by a microphone **53** and video camera **51**, respectively and forwarded to a multiplexer **58**. The subtitle data are entered through either a character generator **55** or a flying spot scanner **56** and encoded by a subtitle encoding circuit **57**. The encoded subtitle information is sent to the multiplexer **58** and combined with the audio/video information onto a record disc **91** or channel for transmission, display, recording or the like.

The video camera **51** generates the video signal and supplies the same to a video encoding unit **52** which converts the video signal from analog to digital form. The digitized video signal is then compressed for video transmission and forwarded to a rate controller **52***a*, which controls the rate that the compressed video data is transferred to the multiplexer in synchronism with the rate that the subtitles are sent to the multiplexer. In this manner, the compressed video data is combined with the subtitle data at the correct time. Similarly, audio information is obtained by the microphone **53** and encoded by an audio encoding unit **54** before being sent to the multiplexer. The audio encoding unit does not necessarily include a rate controller because the audio data is ultimately recorded on a different track or transmitted over a different channel from the video data.

The subtitles are generated by either character generator **55** or flying spot scanner **56**. The character generator includes a monitor and a keyboard which allows an operator to manually insert subtitles into a video picture. The operator edits the subtitles by typing the subtitles through the keyboard. The flying spot scanner **56** is provided in the situation where subtitles are already provided in an external video picture. The flying spot scanner scans the video picture and determines where the subtitles are positioned and extracts them from the video picture. The subtitles from the flying spot scanner are pre-processed by the processing circuit **63** to conform with subtitles generated by the character generator and forwarded to the subtitle encoding circuit.

The subtitle data from either the character generator **55** or the processing circuit **63** are then selected for compression. The character generator outputs blanking data, subtitle data and key data. The subtitle data and key data are forwarded to a switch **61** which is switched according to a predetermined timing to select either the subtitle or key data. The selected data from switch **61** is filtered by a filter **72** and supplied to another switch **62**. Switch **62** switches between the blanking data, the filtered data from the character generator and the processed data from the flying spot scanner. When it is determined that no subtitles are present, the blanking data is chosen by the switch **62**. Where subtitles are present, the switch **62** chooses between the character generator data or the flying spot scanner data accordingly. The selected data is then quantized by a quantization circuit **64**, using a quantization based on data fed back from a subtitle buffer verifier **68**. The quantized data, which may be compressed data, are supplied to a switch **69** and, during normal operation, forwarded to a differential pulse code modulation (DPCM) circuit **65** for pulse code modulation. The modulated data is run-length encoded by a run-length coding circuit **66** and variable-length encoded by a variable-length encoding circuit **67** and forwarded to the subtitle buffer verifier **68** for final processing before being sent to the multiplexer **58**.

The subtitle buffer verifier **68** assembles a load block which includes the encoded subtitle data. The frame of the load block is generated by a loading block creator **70** and is referenced by the subtitle buffer verifier in assembling the data into the load block. The subtitle buffer verifier references the load block by causing switch **69** to switch from the output of the quantization circuit **64** to the output of the loading block creator **70**. The loading block creator creates the load block in part with reference to the color look-up table in a color look-up table **71**. For purposes of decoding, the color look-up table is forwarded directly to the subtitle buffer verifier and transferred to the multiplexer as part of the load block.

The subtitle buffer verifier **68** also prepares a header for the subtitle data which contains information indicating whether the data is to be decoded upon normal or special reproduction. Specifically, the subtitle display time (displayed duration) is determined from those signals at 90 kHz accuracy as PTS, those signals using an upper several bits and 90 kHz or those signals synchronized with the video vertical sync pulse. The header also indicates the subtitle display time as determined from the display start/termination time for the particular subtitle. The amount of information, display position, fade in information and fade out information are also stored in the header for transmission with the load block. The subtitle buffer verifier **68** also loads control information such as: normal/trick play information; position information; subtitle encoding information; time code information; and EOP information; and, an upper limit value.

The subtitle buffer verifier **68** verifies that the buffer is sufficiently filled with data without overflowing. This is done by feeding back a control signal (referred to in FIG. 7A as a filter signal) to the quantization circuit **64**. The control signal changes the quantization level of the quantization circuit, thereby changing the amount of data encoded for a particular subtitle. By increasing the quantization level, the amount of data required for the subtitle data is reduced and the bit rate of data flowing to the subtitle buffer verifier is consequently reduced. When the subtitle buffer verifier determines that there is an underflow of data, the control signal decreases the quantization level and the amount of data output from the quantization circuit increases, thereby filling the subtitle buffer verifier.

The subtitles may also be controlled by color wiping. For this purpose, a wipe lever **81** is provided for an operator who

operates the lever to control the color wiping of the subtitles. An adapter 82 adapts the analog signals of the wipe lever to R,G,B color data. The color data is forwarded to the loading block creator 70 to employ the color wiping look-up table in FIG. 12 instead of the normal color look-up table in FIG. 6. The operator is also provided with a monitor 84 which displays the subtitles supplied thereto by a switcher 83 as they are color wiped.

The subtitle buffer verifier 68 may be considered to be symmetrical (meaning that the encoding and decoding circuits employ the same components, but in a reverse order) with the code buffer 22 (FIG. 8). That is, the subtitle buffer verifier accumulates streams of subtitle data for at least one page of subtitles and transfers each page to display buffer 22-2 when the system clock reference (SCR) is aligned with the subtitle display time stamp (PTS). In this manner, pages of subtitle data are forwarded to the multiplexer 58 for multiplexing with the audio/video data. The multiplexed data is then recorded on an optical disc 91, or transmitted to a television receiver or recorded on other suitable media.

The present invention, thus, provides a flexible encoding/decoding method and apparatus that encodes and decodes subtitles to be superimposed on video pictures in real time. The subtitles are also manipulated during encoding, providing a different appearance for the subtitles with different video pictures. In addition, the invention may also be employed to generate subtitle codes instead of actual text, allowing a receiving decoder to change between different languages. It will be appreciated that the present invention is applicable to other applications, such as interactive video where users can be singled out for special messages. It is, therefore, to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

We claim:

1. A subtitle data encoding apparatus for generating subtitles to be multiplexed with video pictures by a multiplexer, said apparatus comprising:

subtitle generating means for separately generating said subtitles for superimposition with a respective video picture selected from among said video pictures;

encoding means for encoding said subtitles into encoded subtitle data; and

buffer means for regulating a flow rate of said encoded subtitle data to transfer said encoded subtitle data contemporaneously with said respective video picture to the multiplexer.

2. The subtitle data encoding apparatus of claim 1, wherein the encoding means comprises:

quantization means for quantizing said subtitles to produce quantized subtitle data; and

coding means for compressing said subtitle data quantized by said quantization means.

3. The subtitle data encoding apparatus of claim 2, wherein the coding means comprises:

pulse code modulation means for performing pulse code modulation on the subtitle data quantized by the quantization means;

run-length coding means for performing run-length coding on the subtitle data modulated by the pulse code modulation means; and

variable length coding means for variable length coding said run-length coded subtitle data.

4. The subtitle data encoding apparatus of claim 1 wherein the encoding means includes a quantizer having a quantization level and the buffer means comprises subtitle buffer verifier means for controlling said flow rate of said encoded subtitle data by controlling the quantization level of said encoding means.

5. The subtitle data encoding apparatus of claim 4 further comprising loading block creator means for creating a load block referenced by said subtitle buffer verifier means, wherein said subtitle buffer verifier means assembles headers of information into said load block and transfers the same to the multiplexer for multiplexing with said respective video picture.

6. The subtitle data encoding apparatus of claim 5 further comprising a color look-up table circuit for storing a color look-up table of color components, and wherein said loading block creator means references said color look-up table in creating said load block, and said subtitle buffer verifier means stores said color look-up table in said load block for transfer to said multiplexer.

7. The subtitle data encoding apparatus of claim 1, wherein the subtitle generating means comprises a character generator including a visual display and a keyboard for keying in said subtitles.

8. The subtitle data encoding apparatus of claim 7, wherein said substitle generating means further comprises a flying spot scanner for automatically extracting said subtitles from an external video source.

9. The subtitle data encoding apparatus of claim 6, further comprising color wiping means for performing color wiping of said subtitles.

10. The subtitle data encoding apparatus of claim 9, wherein said color wiping means performs the color wiping by replacing said color look-up table with a color look-up table having a color wiping format.

11. A subtitle data decoding apparatus for decoding encoded subtitles demultiplexed from video pictures by a demultiplexer and for superimposing said subtitles on said video pictures, said apparatus comprising:

buffer means for regulating a flow rate of said encoded subtitles to read out said encoded subtitles contemporaneously with a display of a respective video picture selected from among said video pictures;

decoding means for decoding said encoded subtitles into decoded subtitles; and

mixing means for mixing said decoded subtitles with said respective video picture such that the decoded subtitles are superimposed on the display of said respective video picture.

12. The subtitle data decoding apparatus of claim 11 further comprising detector means for detecting said encoded subtitles supplied in bit streams and selectively forwarding said bit streams to said buffer means according to a reproduction mode of said subtitle data decoding apparatus.

13. The subtitle data decoding apparatus of claim 11, further comprising scheduling means for controlling read/write access to said buffer means by setting a band width of an I/O port of said buffer means, said band width determined by dividing a rate of data demultiplexed by said demultiplexer by said flow rate of said buffer means.

14. The subtitle data decoding apparatus of claim 11, wherein said decoding means comprises:

inverse variable length coding means for decoding said encoded subtitles forwarded from said buffer means by employing inverse variable length coding; and

inverse run-length coding means for decoding said subtitles from said inverse variable length coding means by performing inverse run-length coding.

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15. The subtitle data decoding apparatus of claim 14 further comprising a 3:4 filter for transforming the subtitles decoded by said inverse run-length coding means into a 4:3 video picture format.

16. The subtitle data decoding apparatus of claim 11 wherein said subtitles are comprised of pixels, and further comprising color look-up table means for generating color components from a color look up table in response to said decoded subtitles, and for determining a mixing ratio for the color components of each pixel in the subtitles, wherein said mixing means mixes said color components according to said mixing ratio with said decoded subtitles.

17. A subtitle data encoding method for generating subtitles to be multiplexed with video pictures by a multiplexer, said method comprising the steps of:

generating said subtitles separately for superimposition with a respective video picture selected from among said video pictures;

encoding said subtitles into encoded subtitle data; and

regulating a flow rate of said encoded subtitle data to transfer said encoded subtitle data contemporaneously with said respective video picture to the multiplexer.

18. The subtitle data encoding method of claim 17, wherein the encoding step further comprises the steps of:

quantizing said subtitles to produce quantized subtitle data; and

compressing said quantized subtitle data.

19. The subtitle data encoding method of claim 18, wherein said compressing step comprises the steps of:

pulse code modulating the quantized subtitle data;

run-length coding the pulse code modulated subtitle data; and

variable length coding said run-length coded subtitle data.

20. The subtitle data encoding method of claim 18 wherein said encoding step comprises controlling said flow rate of said encoded subtitle data by controlling a quantization level at which said subtitle data is quantized.

21. The subtitle data encoding method of claim 20 further comprising:

creating a load block referenced when said flow rate is controlled; and

assembling headers of information into said load block and transferring the same to the multiplexer for multiplexing with said respective video picture.

22. The subtitle data encoding method of claim 21 further comprising:

storing a color look-up table of color components,

referencing said color look-up table when creating said load block; and

storing said color look-up table in said load block for transfer to said multiplexer.

23. The subtitle data encoding method of claim 22, further comprising color wiping said subtitles.

24. The subtitle data encoding method of claim 23, wherein said color wiping comprises replacing said color look-up table with a color look-up table having a color wiping format.

25. The subtitle data encoding method of claim 17, wherein said subtitles are generated by keying in said subtitles from a keyboard and visually displaying said keyed-in subtitles.

26. The subtitle data encoding method of claim 17, wherein said subtitles are generated by automatically extracting said subtitles from an external video source using a flying spot scanner.

27. A subtitle data decoding method for decoding encoded subtitles demultiplexed from video pictures by a demultiplexer and for superimposing said subtitles on said video pictures, said method comprising the steps of:

regulating a flow rate of said encoded subtitles to read out said encoded subtitles from a buffer contemporaneously with a display of a respective video picture selected from among said video pictures;

decoding said encoded subtitles into decoded subtitles; and

mixing said decoded subtitles with said respective video picture such that the decoded subtitles are superimposed on the display of said respective video picture.

28. The subtitle data decoding method of claim 27 further comprising selectively buffering bit streams supplied to said buffer which correspond to a designated reproduction mode.

29. The subtitle data decoding method of claim 28, further comprising scheduling read/write access to said buffer by setting a band width of an I/O port of said buffer, said band width being determined by dividing a rate of data demultiplexed by said demultiplexer by said flow rate of said bit streams.

30. The subtitle data decoding method of claim 27, wherein said decoding step comprises:

inverse variable length coding said subtitles read out from said buffer; and

inverse run-length coding said inverse variable length coded subtitles.

31. The subtitle data decoding method of claim 30 further comprising 3:4 filtering said inverse run-length coded subtitles into a 4:3 video picture format.

32. The subtitle data decoding method of claim 27 wherein said subtitles are comprised of pixels, and further comprising:

generating color components from a color look up table in response to said decoded subtitles;

determining a mixing ratio for the color components of each pixel in the subtitles; and

mixing said color components according to said mixing ratio with said decoded subtitles.

33. A subtitle processor for processing subtitle data comprising:

bit stream select means for selecting a respective bit stream of the subtitle data from among a plurality of supplied subtitle data bit streams;

time display stamp means for indicating a time when said selected bit stream is to be decoded;

decode start means for initiating decoding of said selected bit stream at said time indicated by said time display stamp means; and

mixing means for mixing said selected bit stream decoded by said decode start means with video picture data.

34. The subtitle processor for processing subtitle data according to claim 33 further comprising system reset means for resetting said subtitle processor.

35. The subtitle processor for processing subtitle data according to claim 33 further comprising channel select means for selecting a channel carrying different sets of said bit streams, each set representing a different video broadcast.

36. The subtitle processor for processing subtitle data according to claim 33 further comprising buffer clear means for dumping said respective bit stream upon detection of corrupt data.

37. The subtitle processor for processing subtitle data according to claim 33 further comprising special reproduc-

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tion means for setting the subtitle processor in a special reproduction mode by causing said bit stream select means to select special reproduction bit streams from among said bit streams.

38. The subtitle processor for processing subtitle data according to claim 33 further comprising squeeze means for initiating a 4:3 conversion of a subtitle picture composed of said bit streams selected by said selected bit stream.

39. The subtitle processor for processing subtitle data according to claim 33 further comprising vertical position means for designating a vertical display position of a subtitle composed of said selected bit stream to said mixing means.

40. The subtitle processor for processing subtitle data according to claim 33 further comprising on/off means for causing said mixing means to selectively display said bit streams as a subtitle picture.

41. The subtitle processor for processing subtitle data according to claim 33 further comprising color look up table means for providing a color look up table, means for generating color components from said subtitle data making up a subtitle picture by referencing said color look up table.

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US005751373A

United States Patent [19]

Ohyama et al.

[11] Patent Number: 5,751,373

[45] Date of Patent: May 12, 1998

[54] **TELEVISION FUNCTION SELECTION METHOD, TELEVISION RECEIVER AND REMOTE COMMANDER FOR TELEVISION RECEIVER**

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[73] Assignee: **Sony Corporation**, Tokyo, Japan

[21] Appl. No.: **623,112**

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[52] **U.S. Cl.** **348/569**; 348/734; 348/564

[58] **Field of Search** 348/563, 564, 348/569, 725, 734, 589, 600; H04N 5/445, 5/50, 9/74, 9/76

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Primary Examiner—Sherrie Hsia

Attorney, Agent, or Firm—Jay H. Maioli

[57] **ABSTRACT**

A method and apparatus by which function as of a television receiver can be selected simply. A main menu displays the highest level of a hierarchical menu which includes items corresponding to functions of a television receiver is displayed on a left side portion of a screen of the television receiver. When a cursor is moved to the first item of the main menu, while the main menu remains displayed on the screen, a sub menu corresponding to the first item is displayed on a right side portion of the screen. When the cursor is subsequently moved to one of the items forming the sub menu and then a predetermined operation is performed.

13 Claims, 22 Drawing Sheets

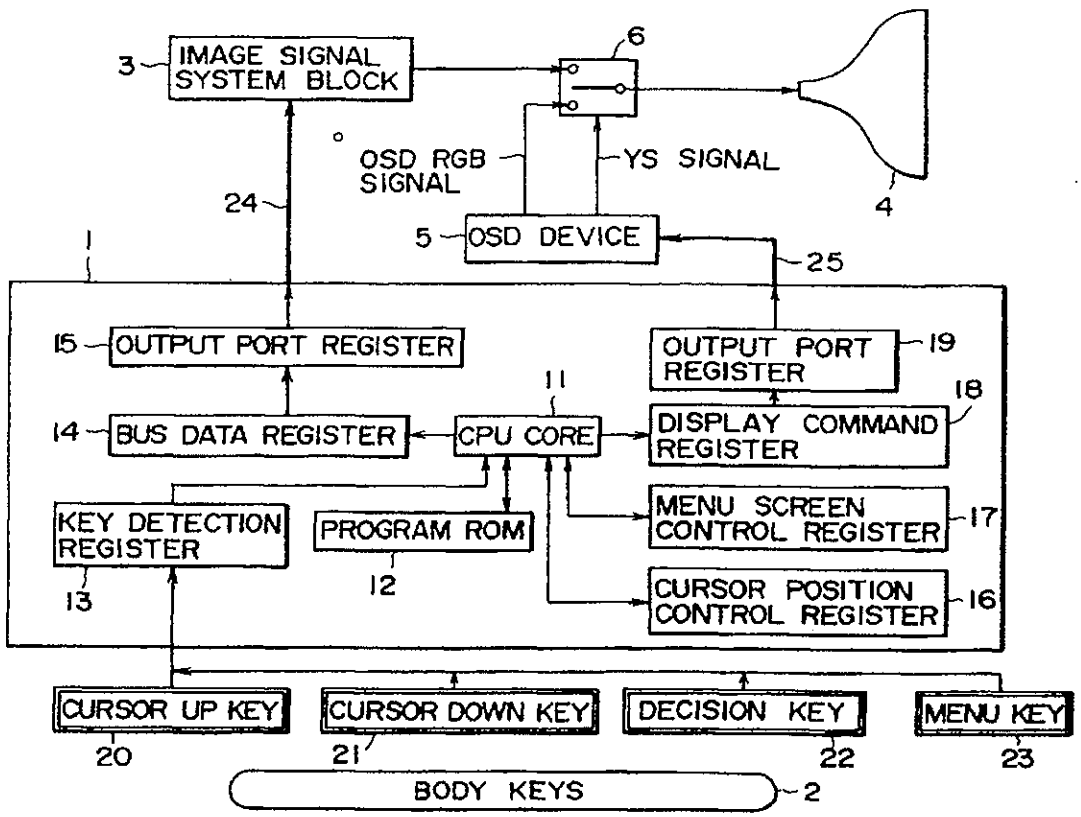

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FIG. 1

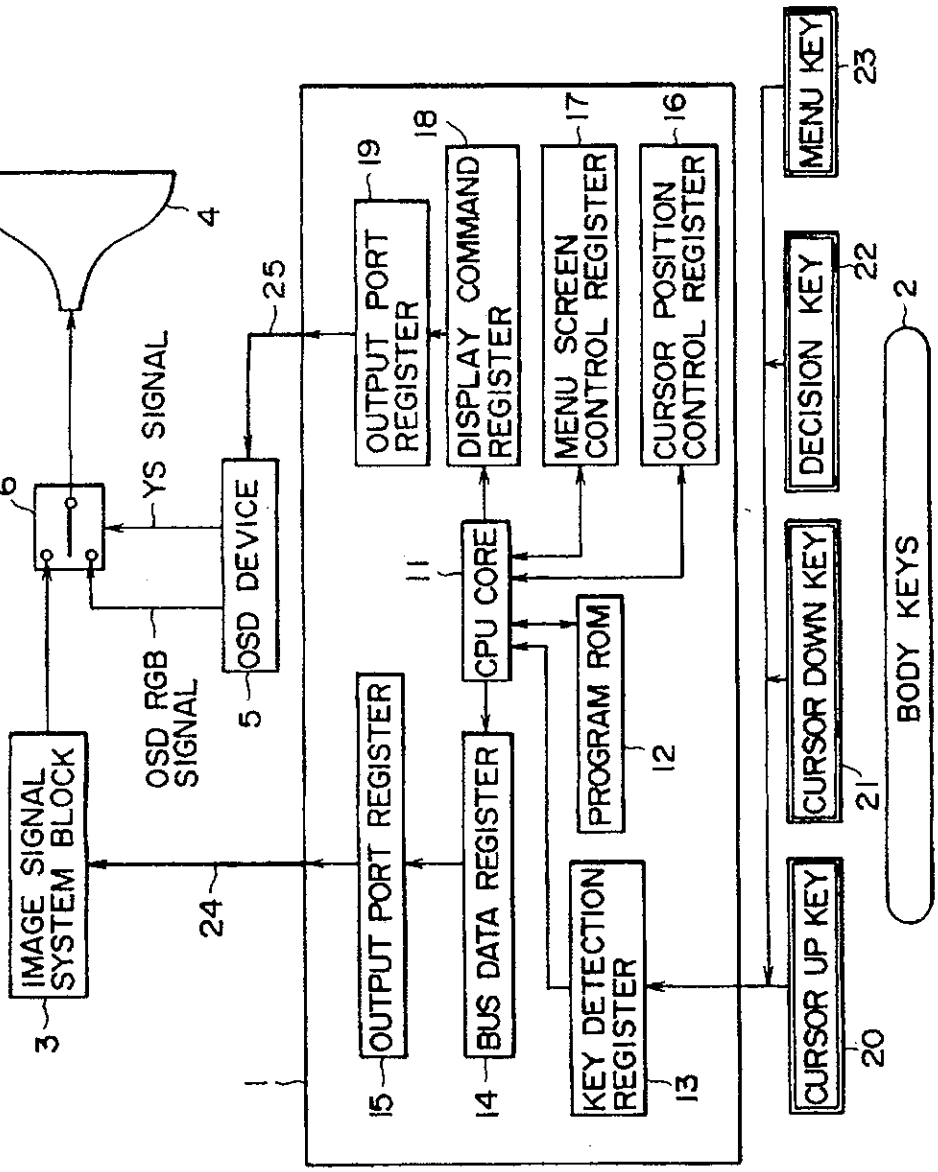

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FIG. 2A

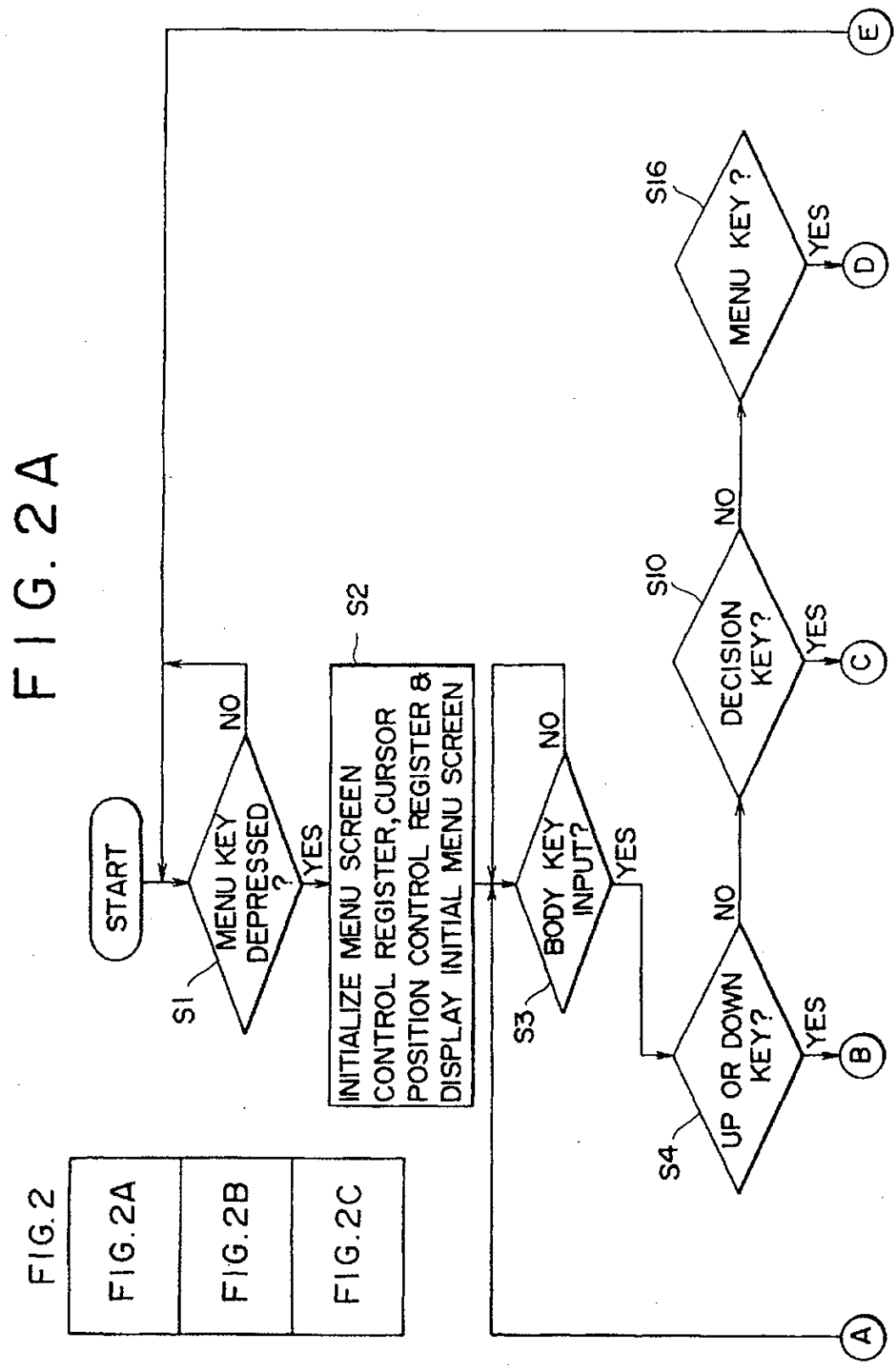

FIG. 2

FIG. 2A	FIG. 2B	FIG. 2C

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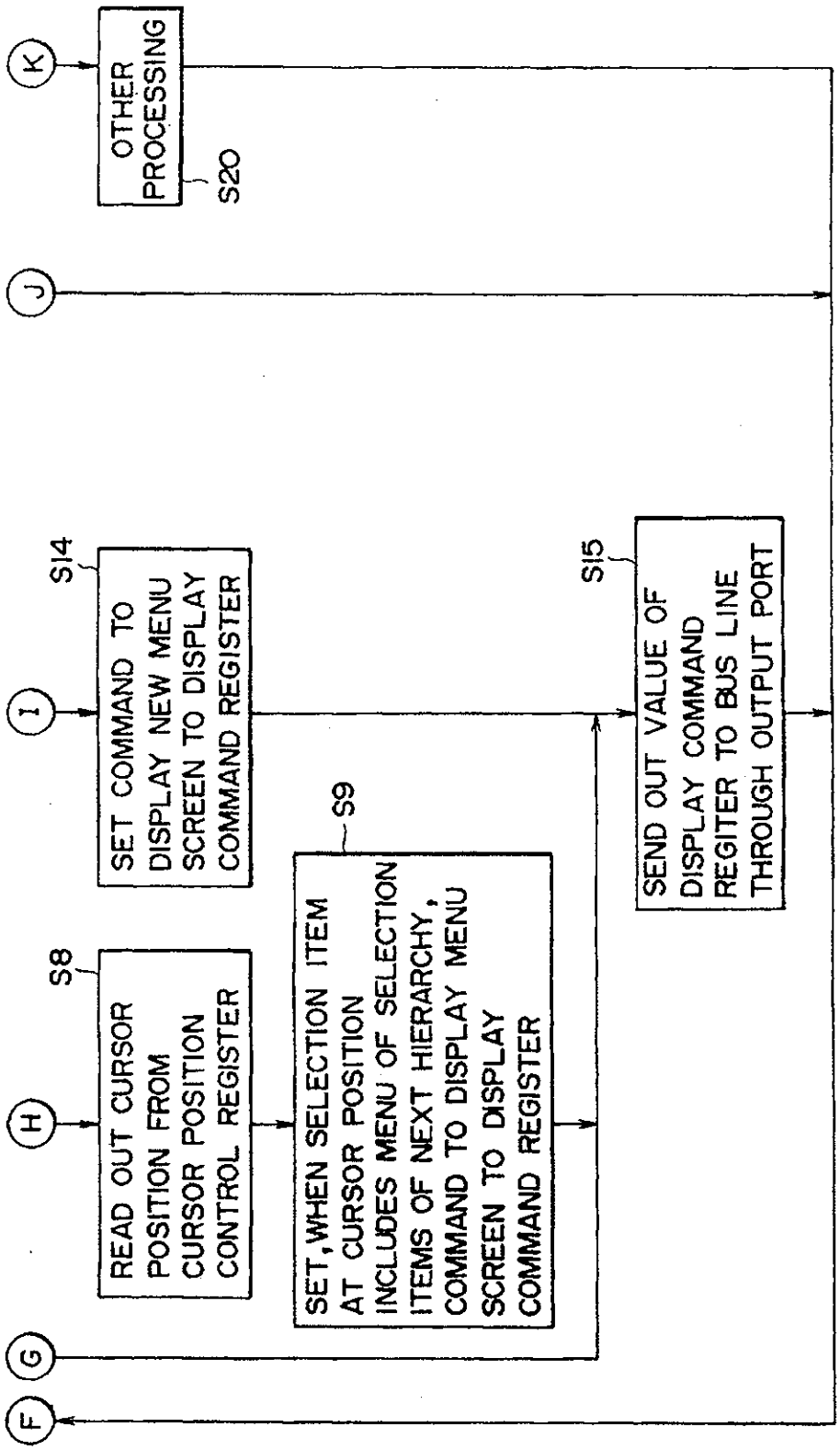

FIG. 2C

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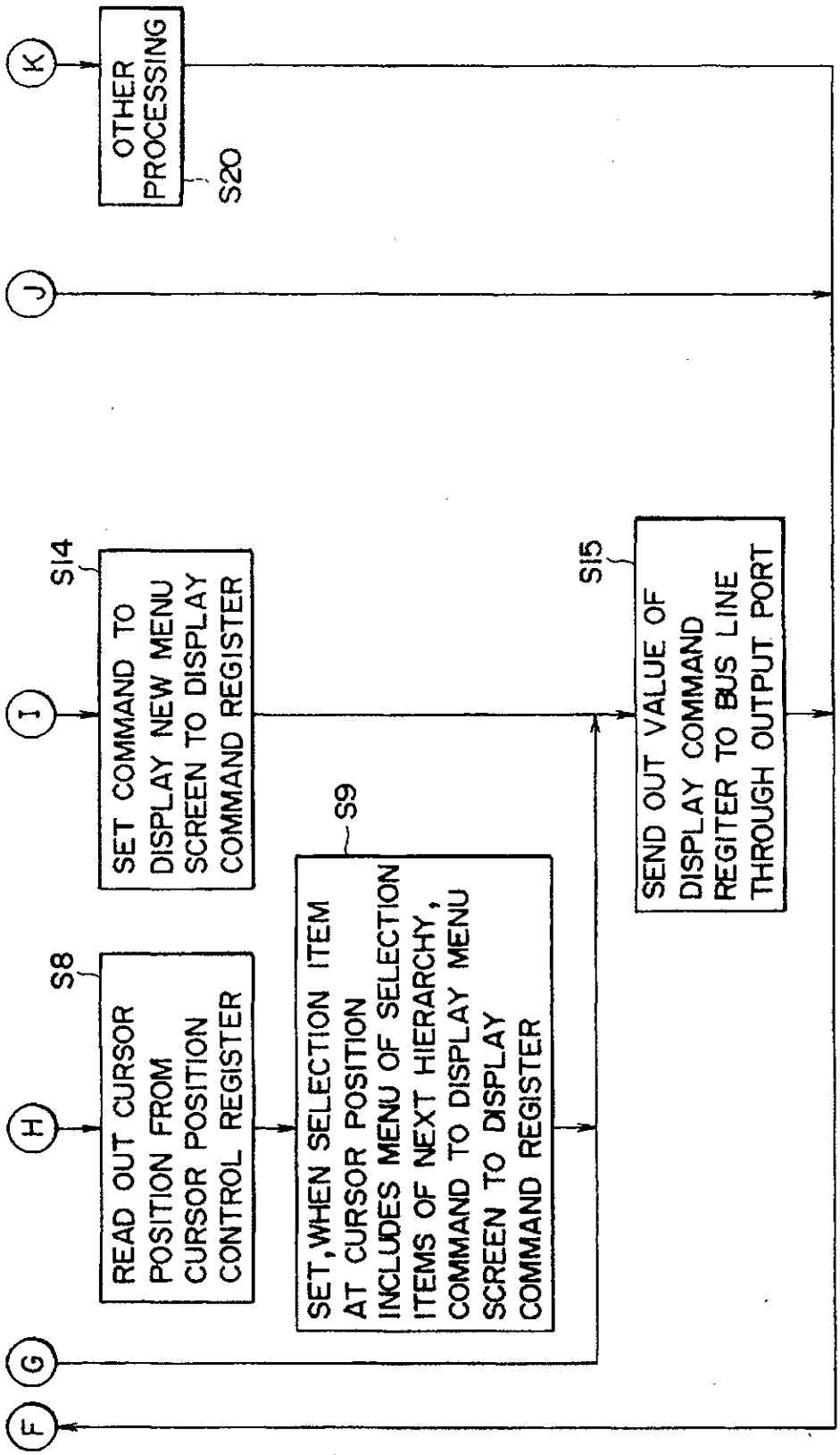

FIG. 2C

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FIG. 3

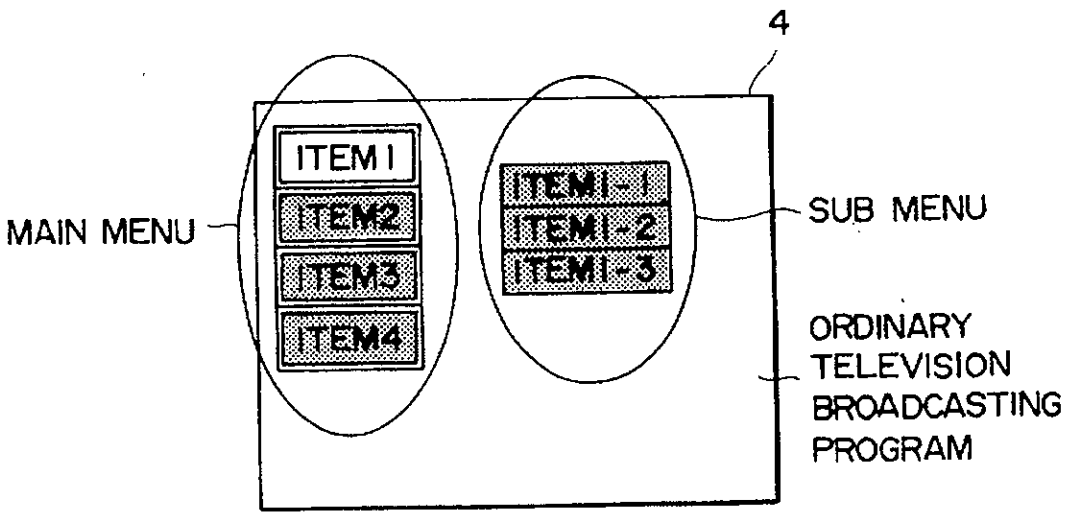

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FIG. 4A

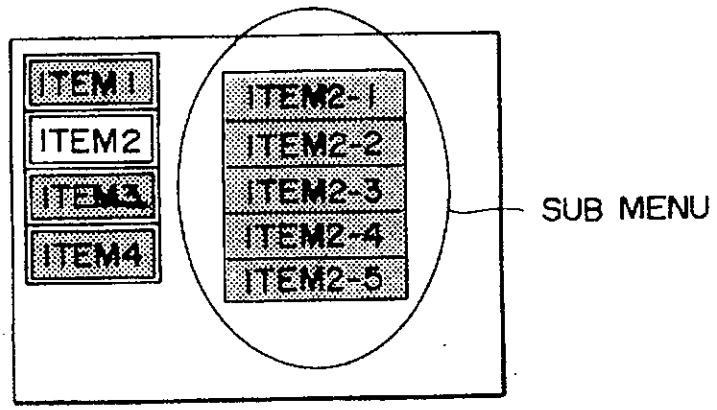

FIG. 4B

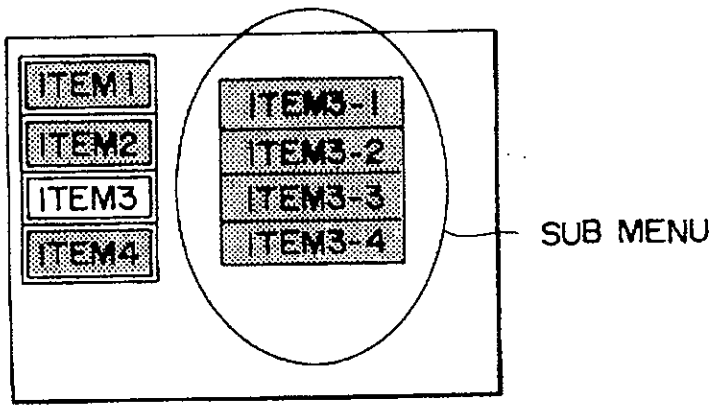

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FIG. 5

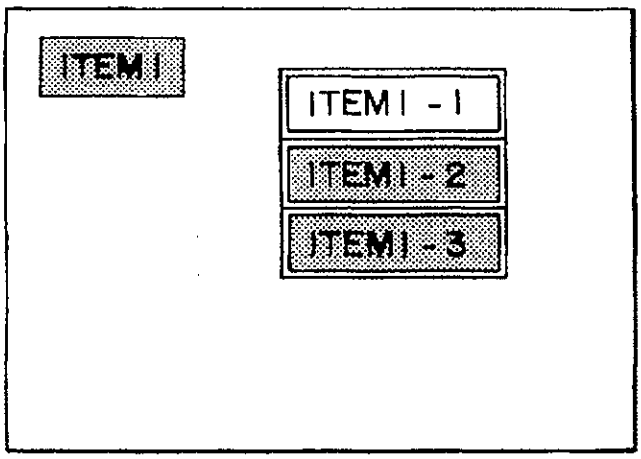

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FIG. 6A

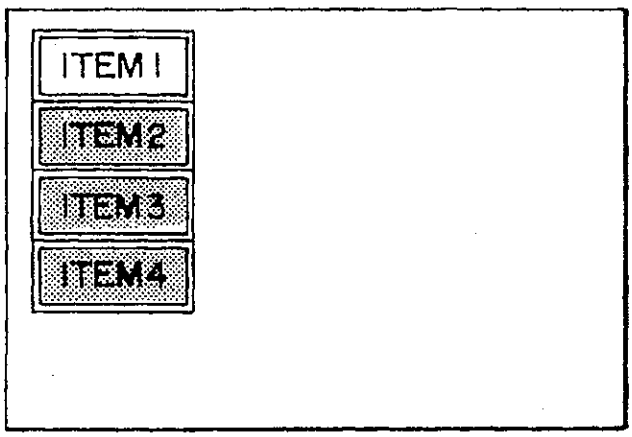

FIG. 6B

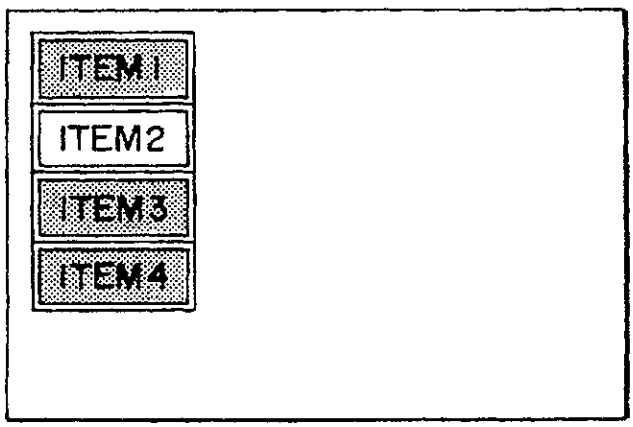

FIG. 6C

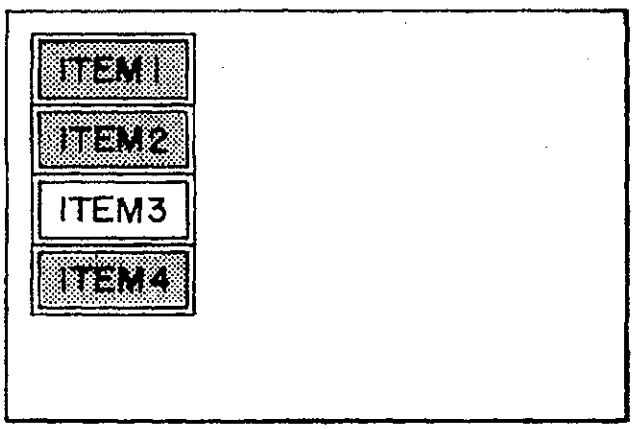

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FIG. 7

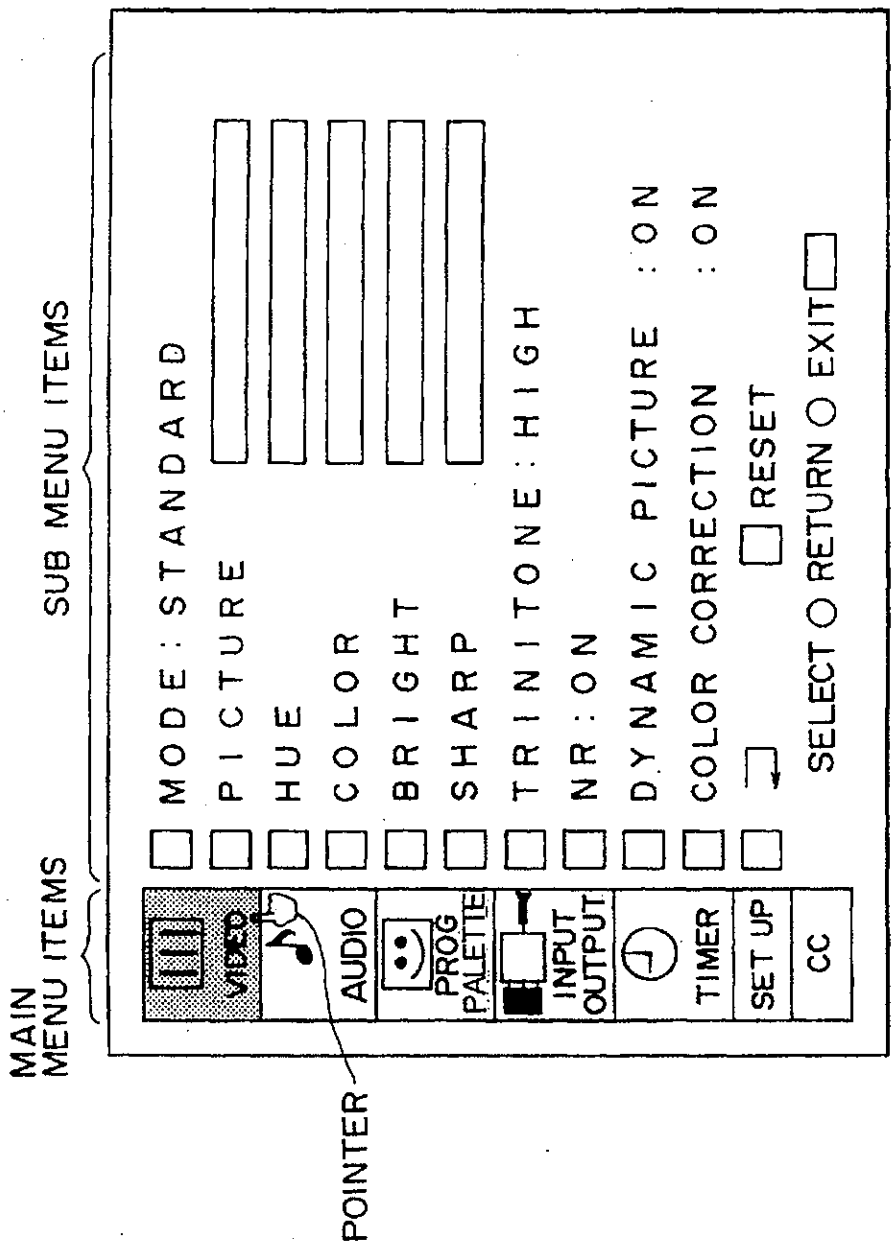

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FIG. 8

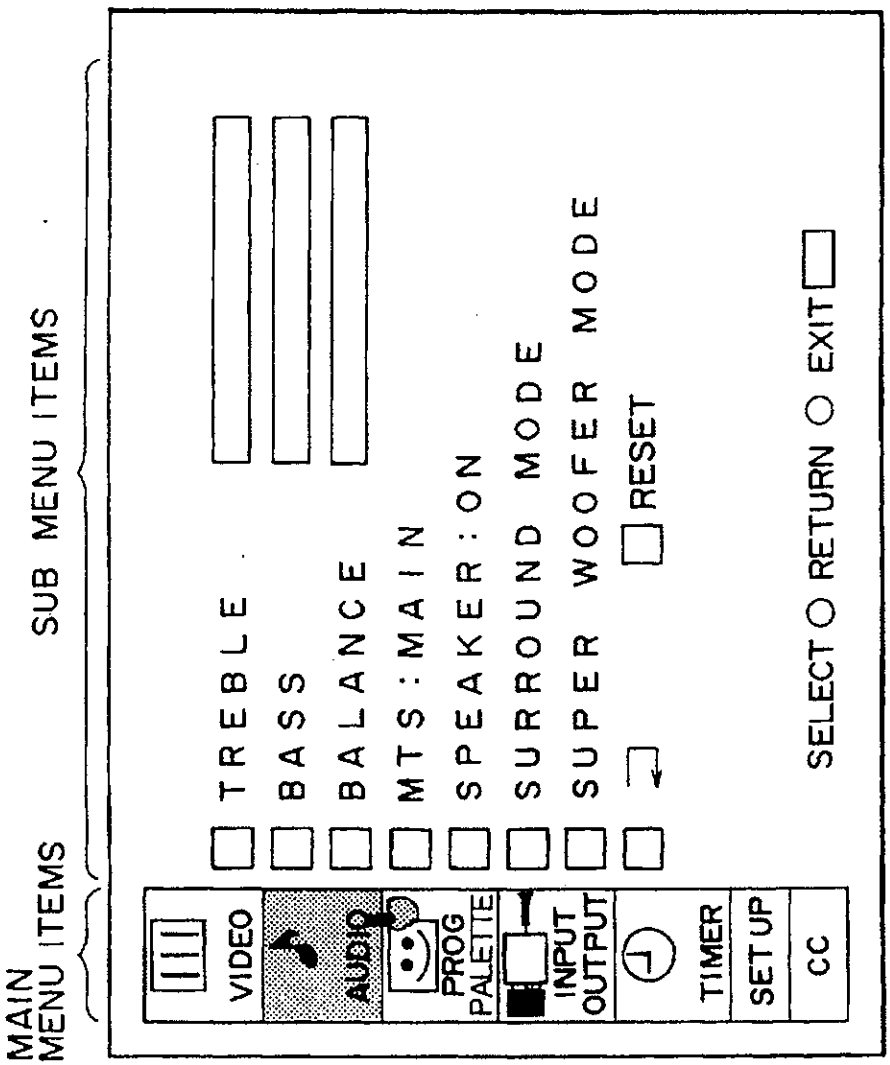

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FIG. 9

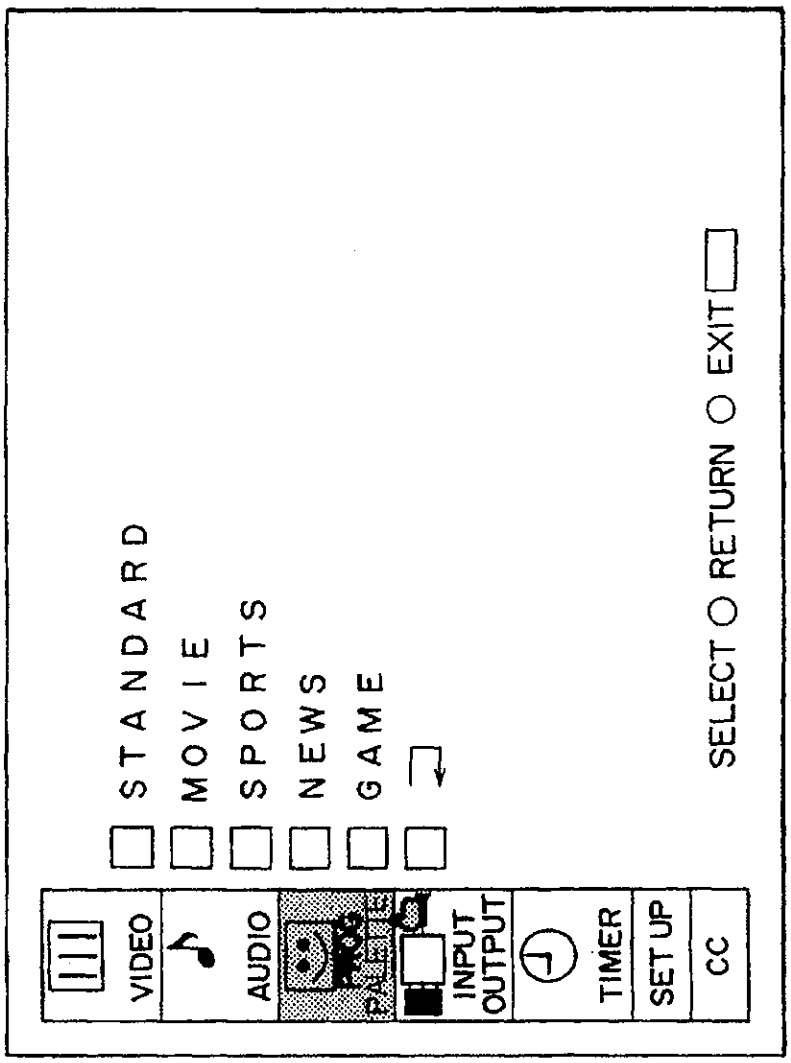

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FIG. 10

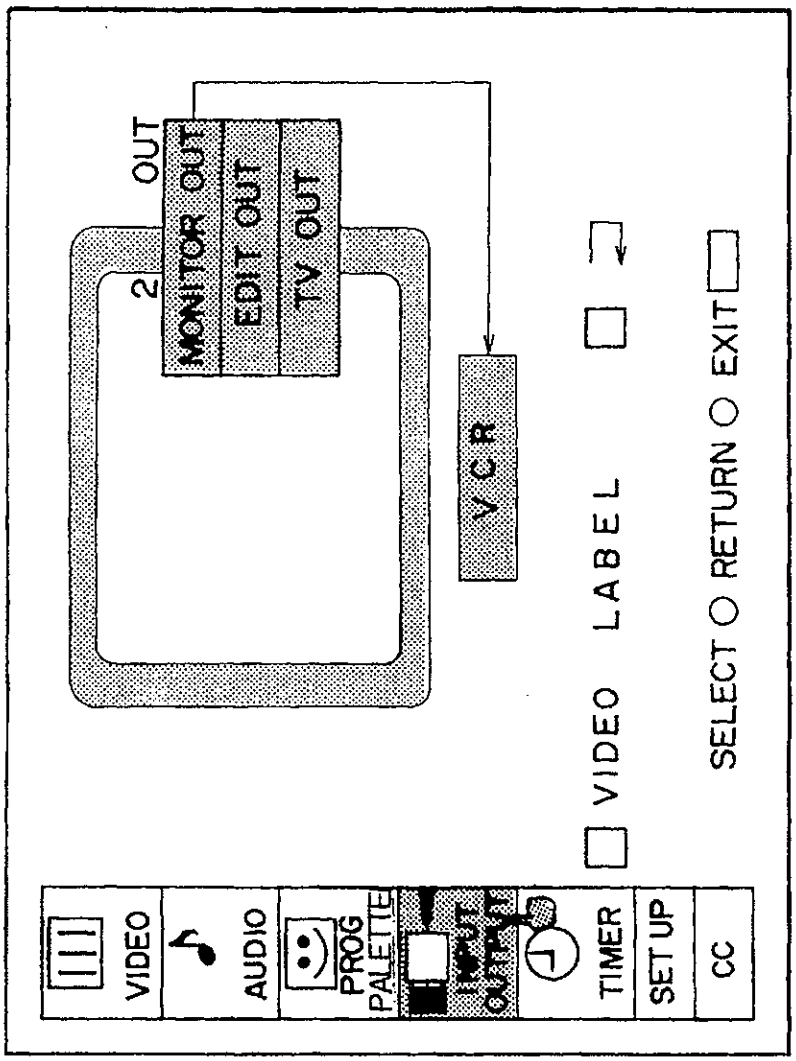

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FIG. 11

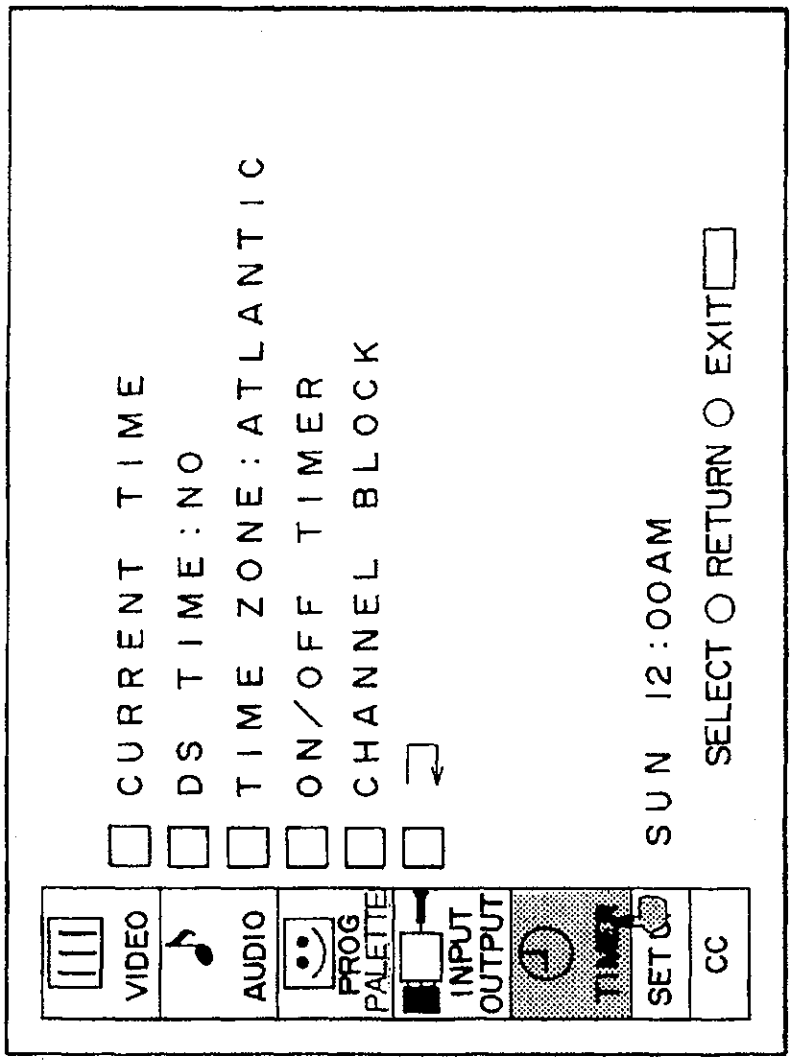

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FIG. 12

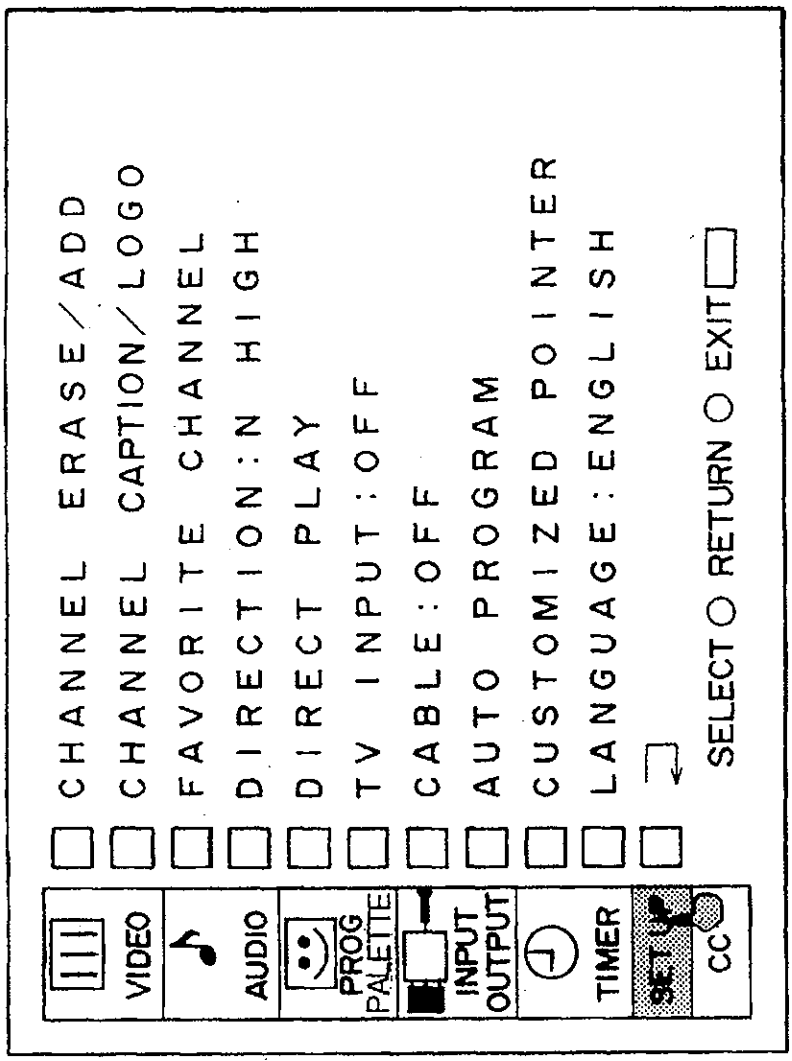

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FIG. 13

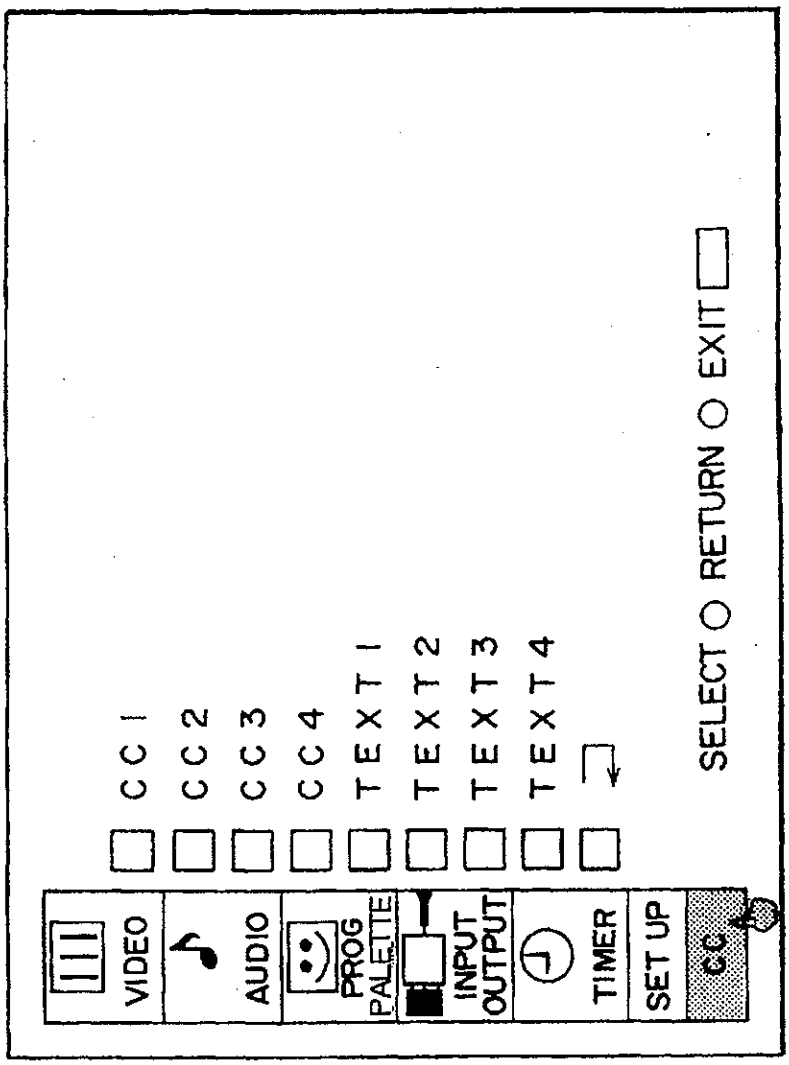

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FIG. 14

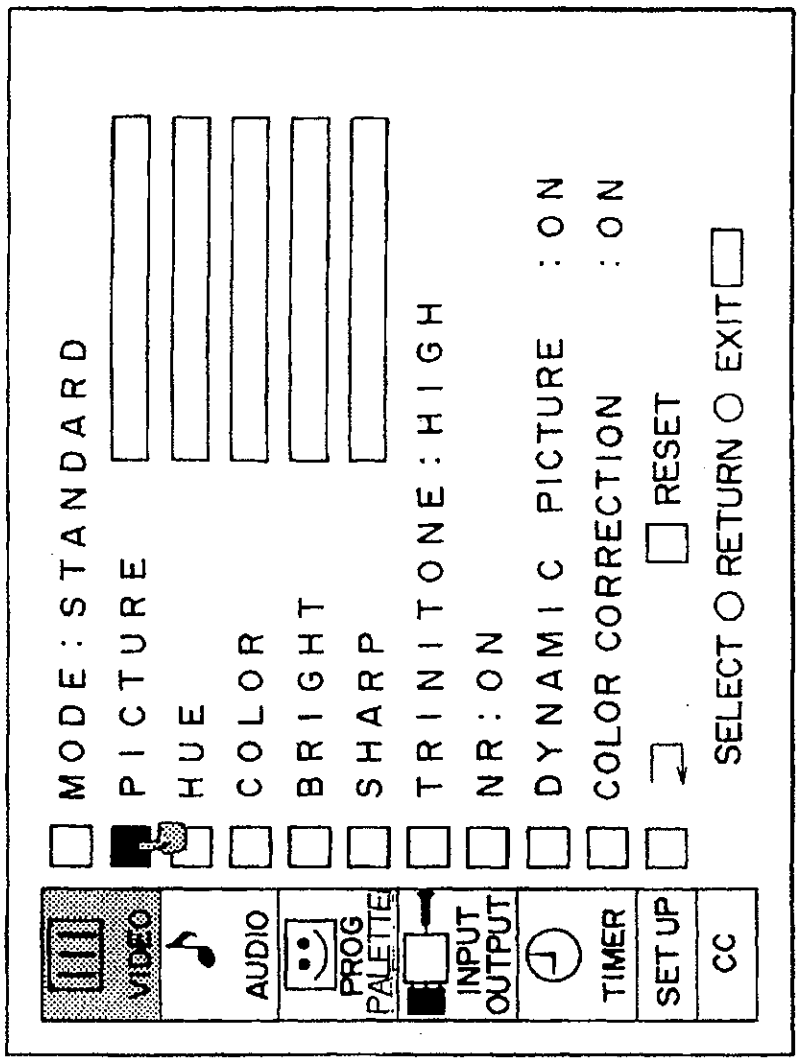

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FIG. 15

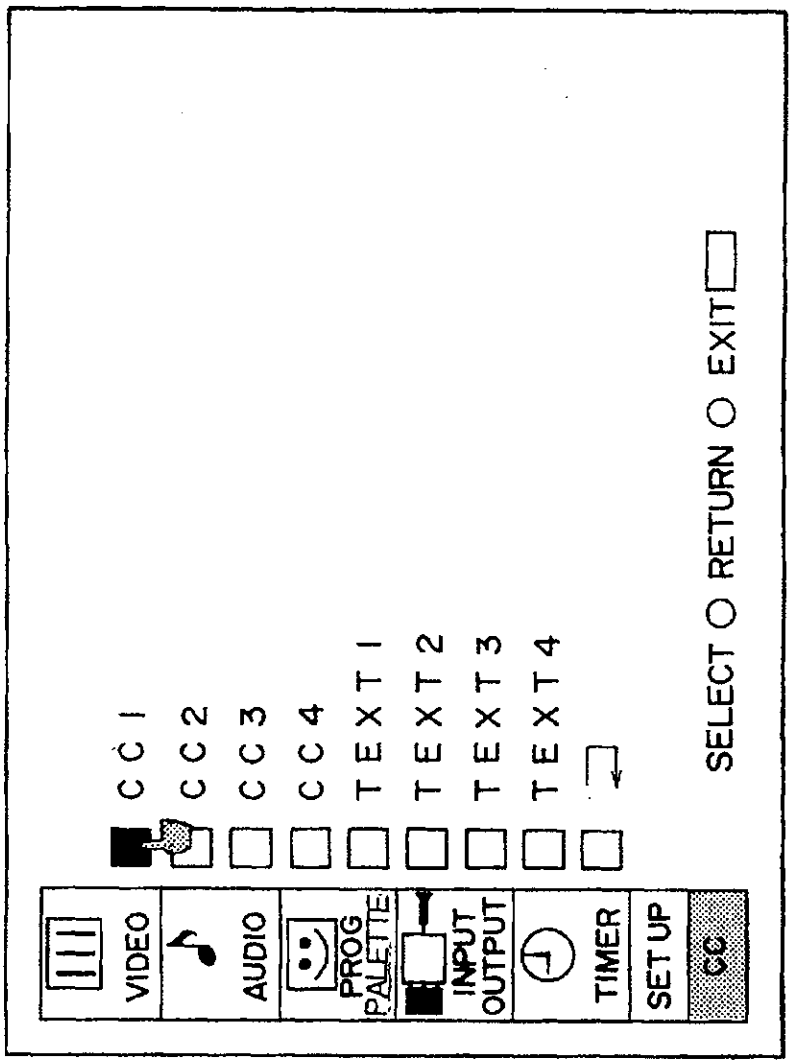

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FIG. 16

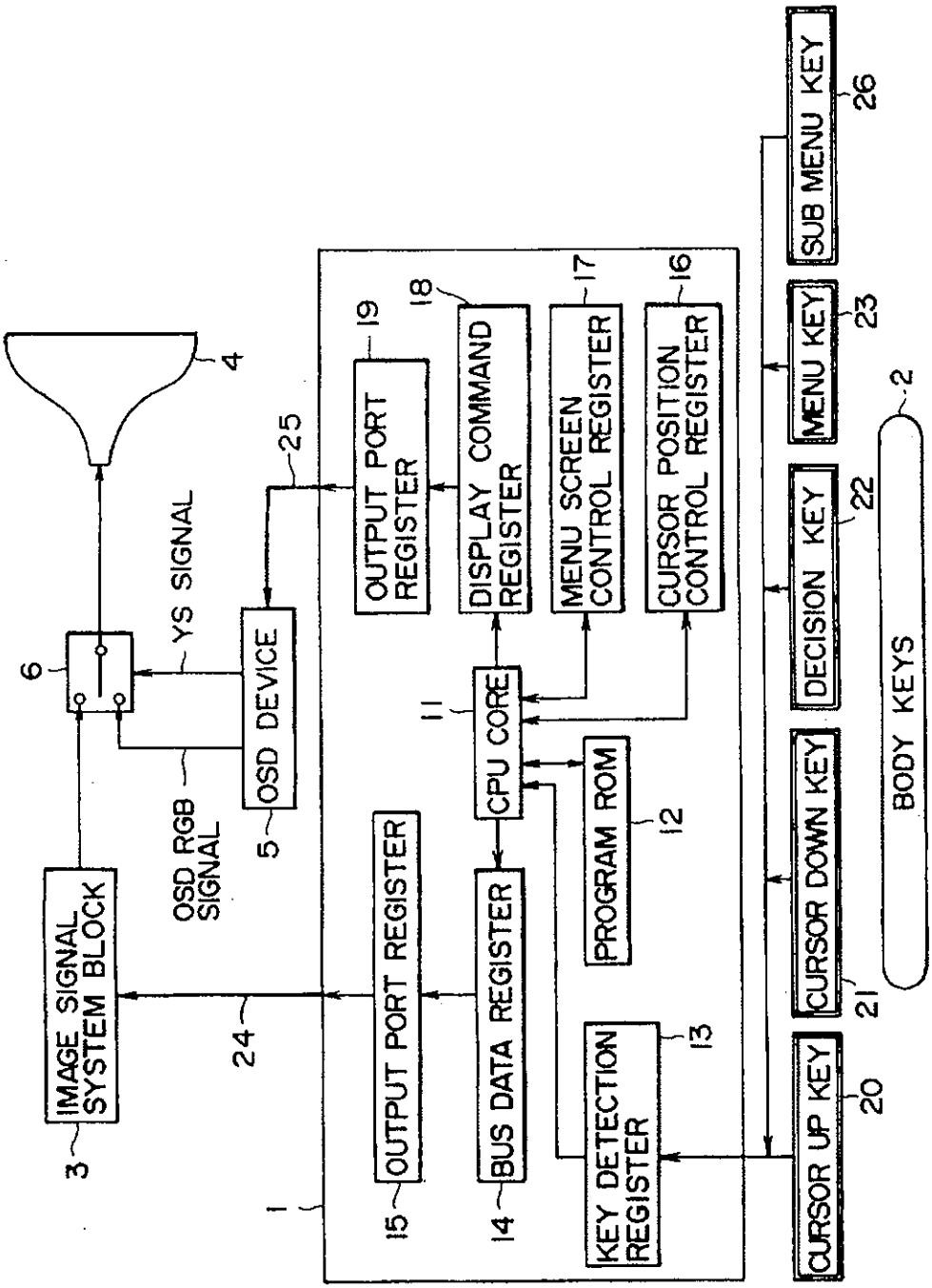

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FIG. 17

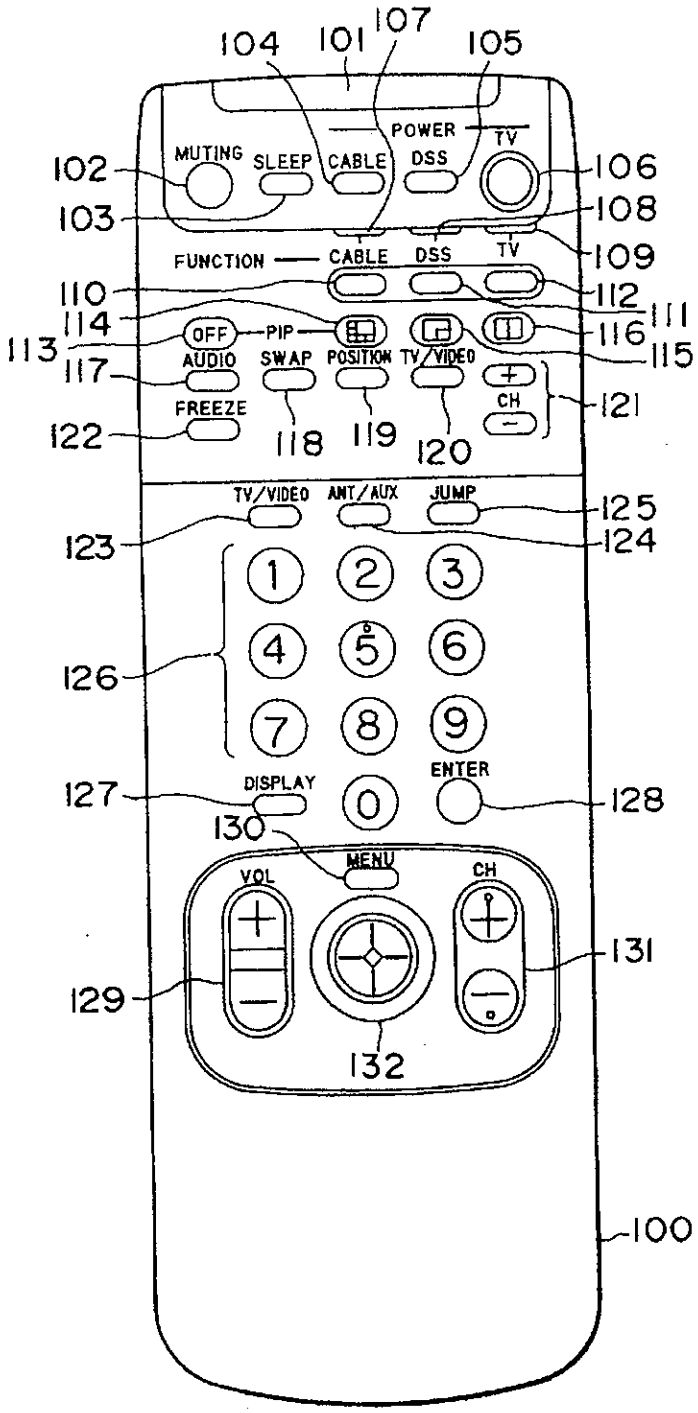

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FIG. 18

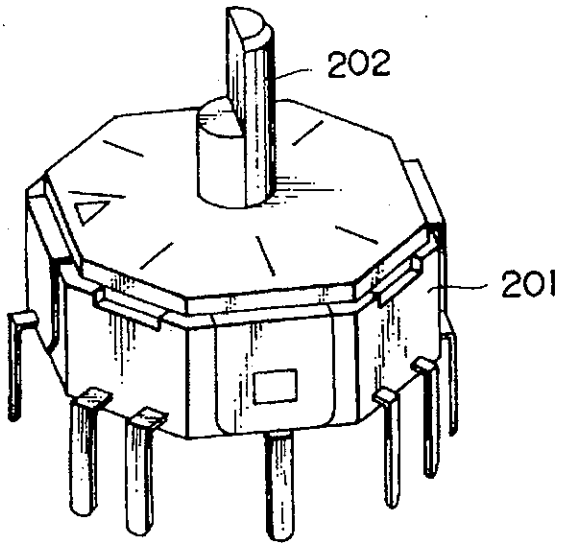
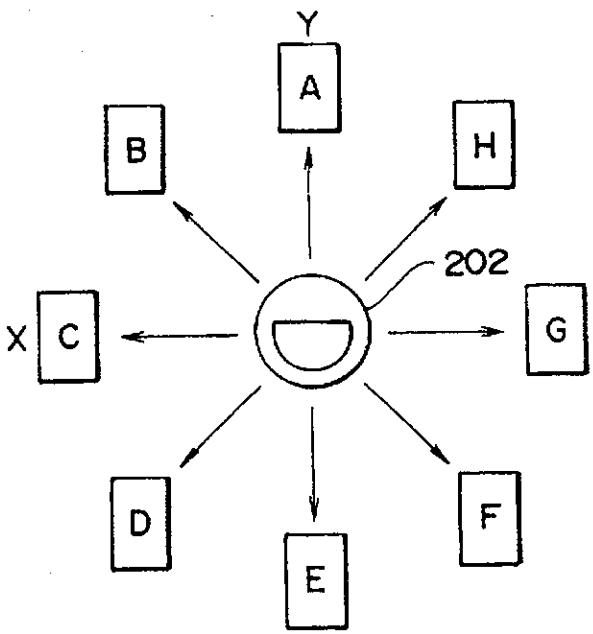


FIG. 19



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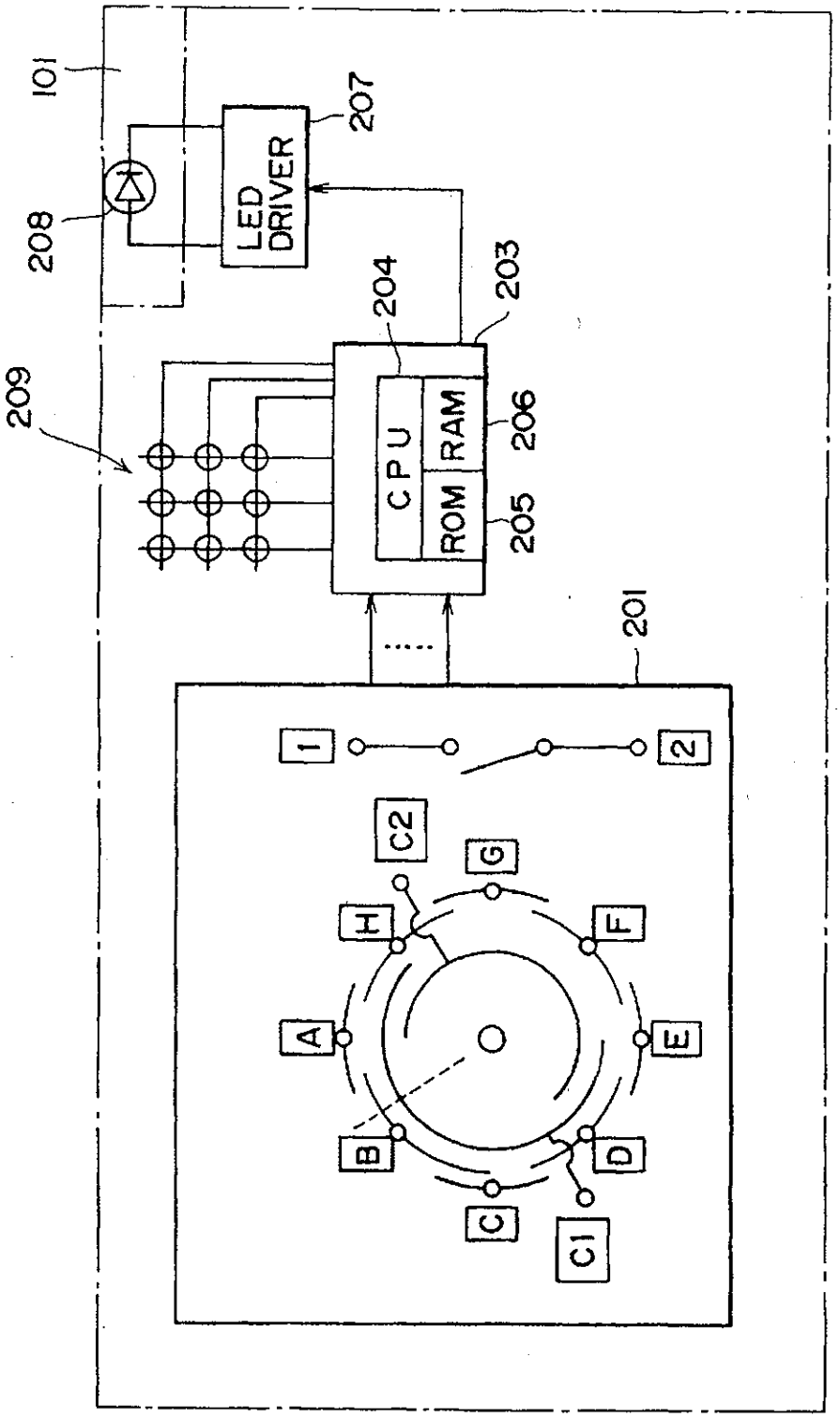

FIG. 20

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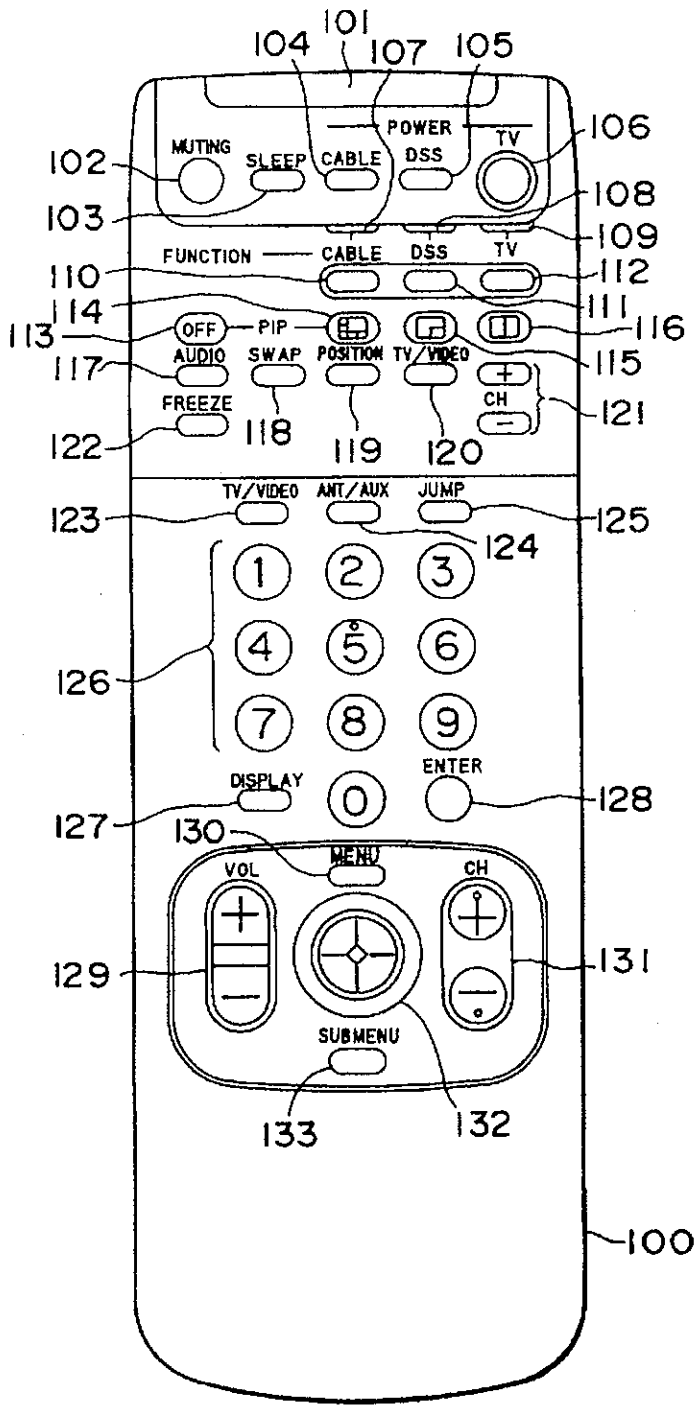
FIG. 21



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TELEVISION FUNCTION SELECTION METHOD, TELEVISION RECEIVER AND REMOTE COMMANDER FOR TELEVISION RECEIVER

BACKGROUND OF THE INVENTION

This invention relates to a television function selection method, a television receiver and a remote commander for a television receiver, and more particularly to a television function selection method, a television receiver and a remote commander for a television receiver wherein, for example, a hierarchical menu is displayed on a screen of the television receiver and a predetermined function is selected from a displayed menu.

Conventionally, in order to select a function of a television receiver, a user first manually operates an operation panel of a television receiver or a remote commander for the television receiver to display a menu corresponding to the highest level of hierarchy on the screen of the television receiver. The menu is formed of a plurality of selection items or alternatives corresponding to functions of the television receiver.

Then, the user manually operates the operation panel or the remote commander to select one of the selection items. When the selected selection item has selection items of a lower hierarchy relating thereto, the menu of the highest hierarchy level is erased, and the menu of the lower hierarchy is displayed on the screen instead. Then, the user selects one of selection items forming the menu of the lower hierarchy which corresponds to a predetermined function. Consequently, a desired function can be selected. Thereafter, the television receiver performs a predetermined operation based on the selected function.

However, in the case where a function of a television receiver is selected in such a manner as described above, when a menu of a lower hierarchy is displayed, since a menu of a hierarchy at the higher position in the hierarchical structure than the lower hierarchy is erased, it is difficult to understand the relationship between the upper hierarchy and the lower hierarchy. Accordingly, it sometimes occurs that, before a selection item desired to be selected finally is displayed and selected, changing over between hierarchies must be repeated several times. Therefore, the conventional selection of a function of a television receiver is disadvantageous in that complicated cumbersome operations are required.

Further, when it is attempted to select a predetermined selection item from among selection items forming a menu of an upper hierarchy, since selection items of a menu of a lower hierarchy relating to the predetermined selection item cannot be displayed prior to the selection, it is difficult to recognize the structure of the hierarchical menu. Consequently, the conventional selection of a function of a television receiver is disadvantageous also in that even a user who understands a menu structure to some degree must recall the menu structure to mind every time. Operations are difficult for ordinary users.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a television function selection method, a television receiver and a remote commander for a television receiver wherein a function of a television receiver can be selected simply and rapidly.

In order to attain the object described above, according to an aspect of the present invention, there is provided a

television function selection method, comprising the steps of displaying, in a first region of a screen of a television receiver, selection items of one of hierarchies of a hierarchical menu which includes a plurality of hierarchies each including selection items corresponding to functions of the television receiver, designating one of the selection items of the first hierarchy of the menu displayed on the screen of the television receiver, displaying, while the selection items of the first hierarchy of the menu are displayed in the first region of the screen, a lower menu which is a lower hierarchy to the first hierarchy of the menu displayed and includes relating selection items relating to the designated selection item in a second region of the screen of the television receiver which is outside the first region or outside at least a portion of the first region, selecting the designated selection item of the first hierarchy, and selecting one of the related selection items relating to the selected selection item of the first hierarchy.

In the television function selection method, if one of the selection items of a menu displayed in the first region of the screen is designated, then while the menu remains displayed on the screen of the television receiver, a lower menu which is subordinate to the hierarchy of the menu displayed and includes relating selection items relating to the designated selection item is displayed in the second region of the screen different from the first region. Consequently, menus of a plurality of hierarchies can be displayed simultaneously on the screen of the television receiver. Accordingly, the menu structure can be grasped simply by the user, and a desired function of the television receiver can be selected simply and rapidly without the necessity of performing an unnecessary operation.

The number of the hierarchies of the menu may be equal to or greater than 2.

According to another aspect of the present invention, there is provided a television function selection method, comprising the steps of displaying, in a first region of a screen of a television receiver, selection items of one of hierarchies of a hierarchical menu which includes a plurality of hierarchies each including selection items corresponding to functions of the television receiver, designating one of the selection items of the first hierarchy of the menu displayed on the screen of the television receiver, selecting the designated selection item, displaying, while the selection items of the first hierarchy of the menu or at least the selected selection item is displayed in the first region of the screen, a lower menu which is so subordinate to the first hierarchy of the menu and includes relating selection items relating to the selected selection item in a second region of the screen of the television receiver which is outside the first region or outside at least a portion of the first region, and selecting one of the relating selection items forming the displayed lower menu.

In the television function selection method, if one of the selection items of a menu displayed in the first region of the screen is designated and selected, then while the menu or at least the selected selection item remains displayed in the first region of the screen of the television receiver, a lower menu which is subordinate to the hierarchy of the menu and includes relating selection items relating to the selected selection item is displayed in the second region of the screen different from the first region. Consequently, menus of a plurality of hierarchies can be displayed simultaneously on the screen of the television receiver. Accordingly, the menu structure can be understood simply by the user, and a desired function of the television receiver can be selected simply and rapidly without the necessity of performing a unnecessary operation.

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The number of the hierarchies of the menu may be equal to or greater than 2.

According to a further aspect of the present invention, there is provided a television receiver, comprising a menu display means for displaying, in a first region of a screen of the television receiver, selection items of one of hierarchies of a hierarchical menu which includes a plurality of hierarchies each including selection items corresponding to functions of the television receiver, a designation means for designating one of the selection items of the first hierarchy of the menu displayed by the menu display means, a lower menu display means for displaying, while the selection items of the first hierarchy of the menu are displayed in the first region of the screen by the menu display means, a lower menu which is subordinate to the first hierarchy of the menu and includes relating selection items relating to the selection item designated by the designation means in a second region of the screen of the television receiver which is outside the first region or outside at least a portion of the first region, a first selection means for selecting the selection item designated by the designation means, and a second selection means for selecting one of the relating selection items relating to the selection item selected by the first selection means.

In the television receiver, if one of the selection items of a menu displayed in the first region of the screen is designated by the designation means, then while the menu remains displayed in the first region of the screen of the television receiver, a lower menu includes relating selection items relating to the designated selection item is displayed in the second region of the screen different from the first region by the lower menu display means. Consequently, menus of a plurality of hierarchies can be displayed simultaneously on the screen of the television receiver. Accordingly, the menu structure can be understood simply by the user, and a desired function of the television receiver can be selected simply and rapidly without the necessity of performing a unnecessary operation.

The number of the hierarchies of the menu may be equal to or greater than 2.

Preferably, the television receiver further comprises a setting means for setting, when one of the selection items of the one hierarchy of the menu displayed by the menu display means is designated by the designation means, whether or not a lower menu which is subordinate to the first hierarchy of the menu should be displayed on the screen, and when the setting means indicates that the lower menu should not be displayed on the screen, the lower menu display means does not display the lower menu on the screen.

In the television receiver, when one of the selection items of a menu displayed on the screen is designated by the designation means, it is set by the setting means whether or not a lower menu corresponding to the designated selection item should be displayed on the screen. Consequently, by setting so that the lower menu should not be displayed on the screen, a function of the television receiver can be selected without disturbing enjoyment of a program of a television broadcast as far as possible.

According to a still further aspect of the present invention, there is provided a remote commander for a television receiver which causes the television receiver to display on a screen of the television receiver a menu including selection items corresponding to functions of the television receiver and instructs, in response to selection of one of the selection items of the menu displayed on the screen of the television receiver, the television receiver to execute a corresponding one of the functions, the remote commander comprising a menu display instruction means for inputting an instruction for displaying, in a first region of a screen of the television receiver, selection items of one of hierarchies of a hierarchical menu which includes a plurality of hierarchies each including selection items corresponding to functions of the television receiver, a designation means for designating one of the selection items of the first hierarchy of the menu displayed on the screen of the television receiver in response to the instruction of the menu display instruction means, a lower menu display instruction means for inputting, while the selection items of the first hierarchy of the menu are displayed in the first region of the screen in response to the instruction of the menu display instruction means, an instruction whether or not a lower menu which is subordinate to the first hierarchy of the menu and includes relating selection items relating to the selection item designated by the designation means should be displayed in a second region of the screen of the television receiver which is outside the first region or outside at least a portion of the first region, a first selection means for selecting the selection item designated by the designation means, and a second selection means for selecting one of the relating selection items relating to the selection item selected by the first selection means.

In the remote commander for a television receiver, one of the selection items of a menu displayed in the first region of the screen is designated by the designation means, and then, while the menu remains displayed in the first region of the screen of the television receiver, it is designated by the lower menu display designation means whether or not a lower menu which includes relating selection items relating to the selection item designated by the designation means should be displayed in the second region of the screen different from the first region. Consequently, menus of a plurality of hierarchies can be displayed simultaneously on the screen of the television receiver. Accordingly, the menu structure can be understood simply by the user, and a desired function of the television receiver can be selected simply and rapidly without the necessity of performing an unnecessary operation.

The number of the hierarchies of the menu may be equal to or greater than 2.

The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings in which like parts or elements are denoted by like reference characters.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing a construction of a television receiver to which the present invention is applied;

FIG. 2 shows a block diagram of FIGS. 2A–2C.

FIGS. 2A–2C are flow charts illustrating operation of the television receiver of FIG. 1;

FIG. 3 is a schematic view showing an example of a menu screen when an item "ITEM 1" of a main menu is designated;

FIGS. 4A and 4B are schematic views showing an example of menu screens when items "ITEM 1" and "ITEM 2" of the main menu are designated, respectively;

FIG. 5 is a schematic view showing an example of a menu screen when an item "ITEM 1-1" of a sub menu is designated;

FIGS. 6A, 6B and 6C are schematic views showing examples of a menu screen when the display of the sub menu is erased;

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FIG. 7 is a schematic view showing an example of a menu screen when an item "VIDEO" of the main menu is designated;

FIG. 8 is a schematic view showing an example of a menu screen when an item "AUDIO" of the main menu is designated;

FIG. 9 is a schematic view showing an example of a menu screen when an item "PROG PALETTE" of the main menu is designated;

FIG. 10 is a schematic view showing an example of a menu screen when an item "INPUT OUTPUT" of the main menu is designated;

FIG. 11 is a schematic view showing an example of a menu screen when an item "TIMER" of the main menu is designated;

FIG. 12 is a schematic view showing an example of a menu screen when an item "SETUP" of the main menu is designated;

FIG. 13 is a schematic view showing an example of a menu screen when an item "CC" of the main menu is designated;

FIG. 14 is a schematic view showing an example of a menu screen when an item "PICTURE" of the item "VIDEO" of the main menu is designated;

FIG. 15 is a schematic view showing an example of a menu screen when an item "CC1" of the item "CC" of the main menu is designated;

FIG. 16 is a block diagram showing a construction of another television receiver to which the present invention is applied;

FIG. 17 is a schematic view showing an arrangement of buttons of a remote commander to which the present invention is applied;

FIG. 18 is a perspective view showing a structure of a select button switch of the remote commander of FIG. 17;

FIG. 19 is a diagrammatic view showing directions in which the select button switch of FIG. 18 can be moved;

FIG. 20 is a block diagram showing an internal construction of the remote commander of FIG. 17; and

FIG. 21 is a schematic view showing an arrangement of buttons of another remote commander to which the present invention is applied.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is shown in block diagram a construction of a television receiver to which the present invention is applied. The television receiver includes a body key apparatus 2 (setting means) which in turn includes a cursor up (Cursor UP) key 20 (designation means), a cursor down (Cursor DOWN) key 21 (designation means), a decision key 22 (first selection means, second selection means) and a menu (Menu) key 23. If one of the keys of the body key apparatus 2 is selectively depressed, then a signal corresponding to a key code of the depressed key is supplied to a system control microcomputer (system controlling microcomputer) 1.

The system control microcomputer 1 includes a program ROM (Read Only Memory) 12 in which a predetermined program and various data are stored, a CPU (Central Processor Unit) core 11 for controlling components of the system control microcomputer 1 in accordance with the program stored in the program ROM 12, a key detection register 13 for receiving and holding a signal corresponding to a key code supplied from the body key apparatus 2, a bus data register 14 for storing and outputting predetermined data supplied from the CPU core 11, an output port register 15 for receiving output data from the bus data register 14 and outputting the received data to an bus line 24, a cursor position control register 16 for holding data for control ling the position of a cursor, a menu screen controlling register 17 for holding data for controlling a menu screen, a display command register 18 for holding a display command for displaying a menu, and an output port register 19 for receiving an output signal corresponding to a predetermined command from the display command register 18 and outputting the received signal to another bus line 25. The system control microcomputer 1 controls a video signal system block 3 and an On Screen Display (OSD) device 5 (menu display means, lower menu display means) which will be described below.

The video signal system block 3 is controlled by a control signal supplied thereto from the output port register 15 of the system control microcomputer 1 via the bus line 24 and outputs a predetermined video signal.

The OSD device 5 generates, in accordance with a control signal supplied thereto from the system control microcomputer 1 via the bus line 25, an RGB signal of OSD data corresponding to a character, a graphic form, a cursor or the like for displaying a predetermined menu screen and a control signal (YS signal) for controlling a switch 6. The generated signals are supplied to the switch 6.

The switch 6 is controlled by the CPU core 11 and changes over the internal connection thereof so that it selectively receives one of a video signal supplied from the video signal system block 3 or an RGB signal supplied from the OSD device 5 corresponding to OSD data and supplies the selected signal to a CRT 4.

The CRT 4 displays, on the screen thereof, an image corresponding to a video signal supplied thereto from the switch 6 or a character, a graphic form or the like corresponding to an RGB signal of OSD data.

Operation of the television receiver described above will be described subsequently with reference to the flow charts of FIGS. 2A–2C. First at step S1, it is discriminated whether or not the menu key 23 of the body key apparatus 2 provided on the body of the television receiver is depressed by a user. In the discrimination, the CPU core 11 reads out data stored in the key detection register 13 and discriminates whether or not the data is key code data corresponding to the menu key 23.

When the CPU core 11 discriminates that the menu key 23 is not depressed, the processing at step S1 is executed repetitively. On the other hand, when it is discriminated that the menu key 23 is depressed, the control sequence advances to step S2.

At step S2, initial values are placed into the menu screen controlling register 17 and the cursor position control register 16. In particular, information representing that, for example, the highest hierarchy level of a hierarchical menu is an object of control at present is placed into the menu screen controlling register 17, and information representing that, the cursor is positioned at the first item of the menu of the highest hierarchy level is placed into the cursor position control register 16.

Then, in accordance with the information, the CPU core 11 places a predetermined display command for displaying a corresponding menu screen into the display command register 18. The display command is supplied to the OSD device 5 via the output port register 19 and the bus line 25.

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The OSD device 5 generates an RGB signal of predetermined OSD data corresponding to the display command supplied thereto and supplies the RGB signal to the switch 6. The OSD device 5 further generates a control signal for changing over the internal connection of the switch 6 so that an output signal of the OSD device 5 may be supplied to the CRT 4 or so that a video signal outputted from the video signal system block 3 may be supplied to the CRT 4. The control signal thus generated is supplied to the switch 6.

In particular, where a menu is to be displayed, the internal connection of the switch 6 is changed over so that an output signal of the OSD device 5 may be supplied to the CRT 4, but where a program of an ordinary television broadcast is to be displayed, the internal construction of the switch 6 is changed over so that a video signal outputted from the video signal system block 3 may be supplied to the CRT 4.

As a result, a menu is displayed on the screen of the CRT 4 in a superposed relationship with a program of an ordinary television broadcast as shown in FIG. 3. In this instance, the main menu of the highest hierarchy level is displayed on a left side portion of the screen while a sub menu of a lower hierarchy level is displayed on a right side portion of the screen. In this instance, the main menu is formed of, for example, items "ITEM 1" to "ITEM 4" each formed with an icon, and, the first item "ITEM 1" of the main menu is displayed in such an emphasized condition that it is displayed in a reversed condition or in a highlighted condition. Then, a sub menu of the highlighted "ITEM 1" displayed is displayed on the right side portion of the screen. In this instance, "ITEM 1-1" to "ITEM 1-3" are displayed as the items of the sub menu.

Thereafter, the control sequence advances to step S3, at which it is discriminated whether or not one of the keys of the body key apparatus 2 is depressed. In this instance, the discrimination of depression of a key of the body key apparatus 2 depends upon whether or not key data corresponding to one of the keys of the body key apparatus 2 is stored in the key detection register 13. When it is discriminated that none of the keys of the body key apparatus 2 is depressed, the processing at step S3 is executed repetitively. On the other hand, if it is discriminated that one of the keys of the body key apparatus 2 is depressed, the control sequence advances to step S4.

At step S4, the key data detected by the key detection register 13 is decoded, and it is discriminated whether or not the depressed key of the body key apparatus 2 is one of the cursor up key 20 or the cursor down key 21. If it is discriminated that the depressed key of the body key apparatus 2 is one of the cursor up key 20 or the cursor down key 21, the control sequence advances to step S5. At step S5, a new position of the cursor is determined from the cursor position at present, in this instance, the position of the highlighted displayed item, the kind of the depressed with key. The value of the cursor position control register 16 is re-written with the new cursor position.

Then, the control sequence advances to step S6, at which a display command for displaying the main menu in which an item corresponding to the new cursor position is displayed highlighted on the screen in order to reflect on the screen that the cursor has moved recently is placed into the display command register 18.

Then at step S7, it is discriminated whether or not the television receiver is set by a user so that a sub menu of the lower hierarchy corresponding to the item on the main menu at which the cursor is positioned is to be displayed. Up on the setting whether or not the sub menu should be displayed, as hereinafter described in connection with step S18, a flag for setting the display of a sub menu to be displayed as an item of the main menu on the screen to on (to be displayed) or off (not to be displayed) is selected.

When it is discriminated at step S7 that the television receiver is not set so that a sub menu of the lower hierarchy corresponding to the item at which the cursor is positioned at present is displayed, the control sequence advances to step S15. At step S15, the display command placed in the display command register 18 is outputted to the bus line 25 via the output port register 19 and supplied to the OSD device 5. The OSD device 5 generates an RGB signal of OSD data and a control signal corresponding to the received display command and supplies the signals to the switch 6. The switch 6 changes over the internal connection thereof in response to the control signal supplied thereto and supplies the RGB signal of the OSD data at a predetermined timing to the CRT 4. In this instance, since it is not set by the user so as to display a sub menu, a display command for displaying a sub menu is not placed in the display command register 18, and consequently, the sub menu is not displayed while only the main menu is displayed.

On the other hand, where the television receiver is set so as to display a sub menu of the lower hierarchy, the control sequence advances to step S8, at which information corresponding to the cursor position is read out from the cursor position control register 16. Then, the control sequence advances to step S9, at which, when there is a sub menu of the lower hierarchy relating to the selection item on the main menu at which the cursor is positioned, a display command for displaying the sub menu is placed into the display command register 18, whereafter the control sequence advances to step S15.

If, for example, the cursor down key 21 is depressed by a user, then a display command for displaying a screen on which the cursor is moved to the item "ITEM 2" of the main menu is placed into the display command register 18 and supplied from the output port register 19 to the OSD device 5 via the bus line 25 under the control of the CPU core 11. The OSD device 5 generates an RGB signal of OSD data and a control signal corresponding to the menu screen on which the cursor is moved to the "ITEM 2" and supplies the signal to the switch 6.

The RGB signal supplied to the switch 6 is supplied at a predetermined timing to the CRT 4 as a result of a changing over operation of the switch 6 in accordance with the control signal. Consequently, such a menu screen as shown in FIG. 4A is displayed. In this manner, the "ITEM 2" is displayed highlighted and a sub menu corresponding to the "ITEM 2" is displayed. In this instance, the sub menu of the "ITEM 2" includes items "ITEM 2-1" to "ITEM 2-5".

Further, if the cursor down key 21 is depressed by the user, then such a menu screen as shown in FIG. 4B is displayed in a similar manner as described above. In this instance, the "ITEM 3" is displayed highlighted, and a sub menu of the "ITEM 3" is displayed. Here, the sub menu of the "ITEM 3" includes items "ITEM 3-1" to "ITEM 3-4".

On the other hand, if the selection item on the main menu at which the cursor is positioned has no sub menu of lower hierarchy relating thereto at step S9, then no processing is executed, and the control sequence advances directly to step S15. At step S15, the CPU core 11 produces a display command for displaying the cursor at the cursor position read out from the cursor position control register 16 and supplies the display command to the display command register 18. The display command is thereafter supplied to the OSD device 5 via the output port register 19 and the bus line 25.

The OSD device 5 generates an RGB signal of predetermined OSD data and a control signal in response to the display command supplied thereto and supplies the signals to the switch 6. The RGB signal supplied to the switch 6 is supplied at a predetermined timing to the CRT 4, on which a corresponding menu screen is displayed. In this instance, the predetermined item of the main menu is displayed highlighted, and no corresponding sub menu to the item is displayed since such sub menu does not exist.

If it is discriminated at step S4 that the depressed key of the body key apparatus 2 is neither the cursor up key 20 nor the cursor down key 21, the control sequence advances to step S10, at which it is discriminated whether or not the depressed key of the body key apparatus 2 is the decision key 22. When it is discriminated that the depressed key of the body key apparatus 2 is not the decision key 22, then the control sequence advances to step S16. On the other hand, if the depressed key of the body key apparatus 2 is the decision key 22, the control sequence advances to step S11.

At step S11, for example, information regarding the hierarchy of the menu which is an object of processing at present is read out from the menu screen controlling register 17 while cursor position information regarding the position of the cursor at present is read out from the cursor position control register 16 by the CPU core 11. Then, the control sequence advances to step S12, at which the item on the main menu whose selection has been indicated by the depression of the decision key 22 is recognized based on the information thus read out and it is discriminated whether or not a sub menu of lower hierarchy relating to the recognized item is present.

If it is discriminated that the predetermined item on the main menu whose selection has been indicated does not have a sub menu positioned in a lower hierarchy to it, the control sequence advances to step S18. On the other hand, if it is discriminated that a sub menu of lower hierarchy is present, then the control sequence advances to step S13. At step S13, a pointer in the program which represents the position at which the cursor is present is set to the first item of the sub menu present in the lower hierarchy to the main menu by the CPU core 11. Consequently, processing such as movement of the cursor or selection of an item is thereafter performed on that sub menu of the hierarchy.

Then, cursor position information corresponding to the position of the first item of the sub menu is written into the cursor position control register 16 so that the cursor may be displayed on the first item of the sub menu.

Thereafter, the control sequence advances to step S14, at which a display command for displaying a new menu screen is produced by the CPU core 11 and placed into the display command register 18. The display command placed in the display command register 18 is supplied, at step S15, to the OSD device 5 via the output port register 19 and the bus line 25. The OSD device 5 generates an RGB signal corresponding to the new menu screen and a control signal in accordance with the display command supplied thereto and supplies the signals to the switch 6. The switch 6 supplies an RGB signal from the OSD device 5 and a video signal from the video signal system block 3 and sends them at a predetermined timing to the CRT 4 in response to the control signal from the OSD device 5.

As a result, a new menu screen as shown in FIG. 5 is displayed on the CRT 4. On the menu screen, the item "ITEM 1" of the main menu and a sub menu of the "ITEM 1" of the main menu are displayed, and "ITEM 1-1" which is the first item of the sub menu is displayed highlighted. In other words, the cursor is positioned at the "ITEM 1-1". Then, as described hereinabove, a manual operation of the cursor up key 20, the cursor down key 21, the decision key 22 or the menu key 23 is performed for the sub menu.

Thereafter, the control sequence advances to step S3 so that the processing at the steps beginning with step S3 is repeated.

On the other hand, if it is discriminated at step S12 that the predetermined item of the main menu whose selection has been settled by the decision key 22 does not have a sub menu positioned subordinate thereto, that is, if it is discriminated that the predetermined item is not an item at which movement of the cursor to a next selection item should be performed but is an item at which predetermined processing which is an object with for which predetermined control is to be performed, the control sequence advances to step S18.

At step S18, it is discriminated whether or not the item whose selection has been indicated is an item for setting the display of a sub menu to on or off. If it is discriminated that the item whose selection has been settled is an item for setting the display of a sub menu to on or off, the control sequence advances to step S19. At step S19, when the display of a sub menu is currently set in an on state, the display of the sub menu is set to off, but when the display of a sub menu is currently set in an off state, the display of the sub menu is set to on.

As a result, when a sub menu is displayed on the screen of the CRT 4, the sub menu is erased, but when no sub menu is displayed on the screen of the CRT 4, the sub menu is displayed newly. FIGS. 6A to 6C shows examples of a screen when the display of a sub menu is set to off. IN particular, FIG. 6A shows an example of a screen when the cursor is positioned at the "ITEM 1" which is the first item of the main menu and the item is displayed highlighted. Similarly, FIG. 6B shows an example of a screen when the cursor is positioned at the "ITEM 2" and the item is displayed highlighted. FIG. 6C shows an example of a screen when the cursor is positioned at the "ITEM 3" and the item is displayed highlighted.

On the other hand, if it is discriminated at step S18 that the item whose selection has been indicated is not an item for setting the display of a sub menu to on or off, the control sequence advances to step S20, at which other processing is executed under the control of the CPU core 11. In particular, predetermined processing corresponding to the item whose selection has been indicated is executed. If it is recognized by the CPU core 11 that the processing is for setting a video mode of the television receiver as hereinafter described, then a corresponding instruction is supplied from the CPU core 11 to the bus data register 14. The instruction is supplied to the video signal system block 3 via the output port register 15 and the bus line 24. The video signal system block 3 generates and outputs a video signal corresponding to the indicate video mode in accordance with the instruction.

On the other hand, if it is discriminated at step S10 that the decision key 22 is not depressed, the control sequence advances to step S16, at which it is discriminated whether or not the menu key 23 is depressed. In the present embodiment, when the depressed key is not any one of the cursor up key 20, the cursor down key 21 or the decision key 22, it is the menu key 23, and consequently, it is discriminated that the menu key 23 is depressed and the control sequence advances to step S17. At step S17, the menu display is turned off.

To this end, the CPU core 11 produces a command for stopping the display of a menu screen and supplies the

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command to the display command register 18. The command supplied to the display command register 18 is supplied to the OSD device 5 via the output port register 19 and the bus line 25. The OSD device 5 generates, in response to the command supplied thereto, a control signal for instructing the switch 6 to change over its internal connection of it so that, for example, a video signal from the video signal system block 3 may be supplied to the CRT 4, and supplies the control signal to the switch 6. As a result, only a video signal from the video signal system block 3 is supplied to the CRT 4, and no menu is displayed.

In this manner, by depressing the menu key 23, a menu of whichever hierarchy is currently displayed, the display of the menu can be ended. When it is desired to display the menu again, the menu key 23 should be depressed again. Accordingly, by depressing the menu key 23, the menu display can be alternately changed over between on and off.

Thereafter, the control sequence returns to step S1 so that the processing beginning with step S1 is repeated.

FIGS. 7 to 15 show different examples of a menu screen which can be used with the television receiver. The main menu is formed of items (icons) displayed on a left side portion of the screen, and here, the following items are displayed. In particular, they are items "VIDEO", "AUDIO", "PROG PALETTE", "INPUT OUTPUT", "TIMER", "SET UP" and "CC".

FIG. 7 shows a condition wherein the pointer (cursor) is positioned on the item "VIDEO" of the main menu and the item is displayed highlighted while a sub menu subordinate to the item is displayed. It can be understood from items of the displayed sub menu that various settings relating to an image can be performed by selective setting of the item "VIDEO" of the main menu.

Where, shown for example in FIG. 17 a remote commander 100 which will be hereinafter described is used, a select button 132 is first manually operated in an upward or downward direction to position the pointer to the item "VIDEO", and then the select button 132 is depressed in a vertical direction so that the selection of the item "VIDEO" can be indicated. This makes it possible to select a desired one of the items of the sub menu corresponding to the item "VIDEO" of the main menu. Consequently, by manually operating the select button 132 in an upward or downward direction, the pointer can be moved to a desired item of the sub menu, and then by depressing the select button 132 in a vertical direction, the item can be selected.

FIG. 8 illustrates a condition wherein the pointer is positioned on the item "AUDIO" of the main menu and the item is displayed highlighted while a sub menu positioned subordinate to the item is displayed. From the items of the displayed sub menu, it can be understood that various settings relating to sound can be performed by selective settlement of the item "AUDIO" of the main menu.

FIG. 9 illustrates a condition wherein the pointer is positioned on the item "PROG PALETTE" of the main menu and the item is displayed highlighted while a sub menu positioned subordinate to the item is displayed. From the items of the displayed sub menu, it can be understood that various settings relating to an image suitable to a kind of a program can be performed by selective settlement of the item "PROG PALETTE" of the main menu. Here, adjustment values of the "PICTURE" and the "COLOR CORRECTION" which can be set in FIG. 7 are set by the user in advance and are prepared as five different program palettes. Then, the user can select one of the palettes.

For example, if the item "MOVIE" of the sub menu is selected, then various adjustment values which can be set are adjusted to values suitable for enjoyment of a program of a movie by settling the selection of the item "VIDEO" of the main menu as described hereinabove. Also with regard to each of the other items "STANDARD", "SPORTS", "NEWS" and "GAME", by selecting the item, the various adjustment values described above are adjusted to values suitable for enjoyment of an ordinary program, a sport program, a news program or a screen of a game.

FIG. 10 illustrates a condition wherein the pointer is positioned on the item "INPUT OUTPUT" of the main menu and the item is displayed highlighted while a sub menu positioned subordinate to the item is displayed. From the items of the displayed sub menu, it can be understood that various settings relating to an input and an output of the television receiver can be performed by selection of the item "INPUT OUTPUT" of the main menu. In the present embodiment, it is shown that a signal is output from a monitor output terminal (MONITOR OUT) of the television receiver and supplied to a video cassette recorder (VCR).

FIG. 11 illustrates a condition wherein the pointer is positioned on the item "TIMER" of the main menu and the item is displayed highlighted while a sub menu positioned subordinate to the item is displayed. From the items of the displayed sub menu, it can be understood that various settings relating to the time can be performed by selection of the item "TIMER" of the main menu.

FIG. 12 illustrates a condition wherein the pointer is positioned on the item "SETUP" of the main menu and the item is displayed highlighted while a sub menu positioned subordinate to the item is displayed. From the items of the displayed sub menu, it can be understood that various initial settings can be performed by selection of the item "SETUP" of the main menu.

FIG. 13 illustrates a condition wherein the pointer is positioned on the item "CC" of the main menu and the item is displayed highlighted while a sub menu positioned subordinate to the item is displayed. From the items of the displayed sub menu, it can be understood that various settings relating to a closed caption or a teletext can be performed by selection of the item "CC" of the main menu. For example, items "CC1" to "CC4" correspond to languages such as English and Spanish, and items "TEXT1" to "TEXT4" correspond to programs of a teletext.

Since the pointer moves on the main menu in response to a manual operation by a user and a sub menu which corresponds to a predetermined item on the main menu at which the pointer is positioned is displayed on a screen in this manner, it can be recognized immediately what setting can be performed by selection the item of the main menu. Accordingly, even if the user is unfamiliar with the operation of the television receiver, the relationship between the main menu and the sub menu can be understood simply, and desired setting can be performed rapidly.

FIG. 14 illustrates an example when the selection of the item "VIDEO" of the main menu is indicated and the pointer is moved to the item "PICTURE" of the sub menu corresponding to the item "VIDEO". Here, if the decision key 22 is depressed to indicated the selection of the item "PICTURE", then the adjustment values of the item "PICTURE" can be set.

FIG. 15 illustrates an example when the selection of the item "CC" is indicated and the pointer is moved to the item "CC1" of the sub menu corresponding to the item "CC". Here, if the decision key 22 is depressed to indicate the selection of the item "CC1", then the television receiver is set so that a closed caption in a predetermined language corresponding to the item "CC1" may be displayed.

FIG. 16 is a block diagram showing a construction of another television receiver to which a second embodiment of the present invention is applied. The television receiver of the present embodiment is a modification to and includes common components to those of the television receiver of the first embodiment described hereinabove with reference to FIG. 1, and accordingly, overlapping description of the common construction is omitted here to avoid redundancy. The television receiver of the present embodiment is different from the television receiver of the preceding embodiment only in that the body key apparatus 2 additionally includes a sub menu key 26 which can input an instruction to change over the display of a sub menu between on and off. If the sub menu key 26 is depressed, then corresponding key data is supplied to and stored into the key detection register 13. The key data is read out by the CPU core 11, and in response to the key data, if the display of a sub menu is currently set on, then the display of the sub menu is set to off, but if the display of a sub menu is currently set off, the display of the sub menu is set to on. Then, when it becomes necessary to re-write the screen as a result of the re-setting of the display of a sub menu, contents of the display command register 18 are re-written by the CPU core 11.

FIG. 17 shows an example of a construction of a button switch arrangement of a remote commander which can be used to operate such a television receiver as shown in FIG. 1. A muting button switch 102 is manually operated to set or cancel a muting condition of the CRT 4. A sleep button switch 103 is manually operated to set or cancel a sleep mode in which the power supply is automatically interrupted when a predetermined point of time comes or when a predetermined time elapses.

When a cable power source button switch 104, a DSS (Digital Satellite System) power source button switch 105 and a television power source button switch 106 are manually operated, a cable box (not shown), a receiver (not shown) for receiving a DSS and the power source for the television receiver are switched off, respectively.

A cable button switch 110, a DSS button switch 111 and a television button switch 112 are button switches for changing over between functions, that is, for changing over between apparatus categories by transmitting a code of an infrared ray signal emitted from a light emitting element 101 of the remote commander 100. In particular, the cable button switch 110 is manually operated when a signal transmitted via a cable and received by the cable box is to be displayed on the CRT 4. In response to the manual operation of the cable button switch 110, a code of an apparatus category allocated to the cable box is emitted as an infrared ray signal. Similarly, the DSS button switch 111 is manually operated when a digital satellite broadcast received via an artificial satellite is to be displayed on the CRT 4. The television button switch 112 is manually operated when a signal received by the tuner (not shown) is to be displayed. LEDs 107, 108 and 109 are lit when the cable button switch 110, the DSS button switch 111 and the television button switch 112 are turned on, respectively. Consequently, it is indicated that, when a button is depressed, to an apparatus of which category a code is transmitted.

A PIP (picture-in-picture) display button switch 114, 115 or 116 is manually operated when a picture-in-picture screen is to be displayed at a predetermined position of the screen of the CRT 4. An OFF button switch 113 is manually operated when the display of a picture-in-picture displayed on the screen is to be ended. An AUDIO button switch 117 is manually operated when an audio output is to be changed over between sound corresponding to an image displayed on the picture-in-picture screen and sound corresponding to an image displayed on the ordinary screen.

A SWAP button switch 118 is manually operated when an ordinary screen and a picture-in-picture screen are to be swapped. A position button switch 119 is manually operated when the position of the screen at which a picture-in-picture screen is to be displayed is to be designated such as, for example, a right upper position, a right lower position, a left upper position or a left lower position of the screen. A television/video change-over button switch 120 is manually operated when a signal to be displayed on the picture-in-picture screen is to be changed over to a signal from the tuner built in the television receiver to an input signal (from a VCR or the like) from a video input terminal. A channel up/down button switch 121 is manually operated when a channel to be displayed on the picture-in-picture screen is to be changed over. A FREEZE button switch 122 is manually operated when an image displayed on the picture-in-picture screen is to be changed to a still picture.

Another television/video change-over button switch 123 is manually operated when a signal to be displayed on the ordinary screen is to be changed over to the signal from the tuner built in the television receiver or to an input signal (from a VCR or the like) from the video input terminal. An antenna/AUX change-over button switch 124 is manually operated to change over an input between an antenna input and an AUX input.

A jump button switch 125 is manually operated to restore an original channel which was received prior to the changing over between the antenna input and the AUX input. Each of numeric button (ten key) switches 126 on which numerals from 0 to 9 are indicated is manually operated when a number indicated thereon is to be inputted. An enter button switch 128 is manually operated after manual operation of the numeric button switches 126 is completed in order to input ending of inputting of a number. When a channel is changed over, a banner including a number, a call sign (name), a logo and a main icon of the new channel is displayed, for example, for 3 seconds. Here, two banners are available including a banner of a simple construction which includes the elements mentioned above and another banner of a more detailed construction which includes, in addition to the elements mentioned above, a name and a broadcast starting time of a program, the present time and so forth. A display button switch 127 is manually operated when the type of a banner to be displayed is to be changed over.

A volume button switch 129 is manually operated when the volume of sound is to be increased or decreased. A menu button switch 130 (menu display instruction means) is manually operated when a menu screen is to be displayed on the CRT 4 or when such display of a menu screen is to be ended. A channel up/down button switch 131 is manually operated when the number of a broadcasting channel to be received is to be increased or decreased.

The select button 132 (designation means, lower menu display instruction means, first selection means, second selection means) not only can be manually operated (directional operation) totaling eight directions including upward, downward, leftward and rightward directions and four intermediate oblique directions, but also can be manually operated or depressed (operation for selection) in a vertical direction with respect to the top face of the remote commander 100.

FIG. 18 shows an example of a construction of a small stick switch which is used as the select button 132. The small stitch is so structured that a lever 202 extends from a body 201. When the select button 132 is directionally operated in one of the eight directions in a horizontal plane, it is pivoted in the operation direction. Further, when the select button 132 is manually operated for selection (operated vertically), the lever 202 is pushed down in a vertical direction.

FIG. 19 shows the eight operation directions of the lever 202 in a horizontal plane. As seen from FIG. 19, the lever

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202 can be directionally operated in the eight directions indicated by A to H in the horizontal plane.

FIG. 20 shows an example of an internal construction of the remote commander 100. Referring to FIG. 19, contacts A to H in the inside of the body 201 of the small stick switch correspond to the eight directions A to H shown in FIG. 19. When the lever 202 is manually operated in one of the directions A to D, a corresponding one of the contacts A to D is connected to a terminal C1. On the other hand, when the lever 202 is pivoted in one of the directions E to H, a corresponding one of the terminals E to H is connected to another terminal C2. Further, between the terminals H and A and between the terminals D and E, both of the terminals C1 and C2 are connected to them, respectively. Further, when the lever 202 is manually operated in a vertical direction, the terminals C1 and C2 are connected to each other.

The connection condition of the terminals of the body 201 is monitored by a CPU 204 of a microcomputer 203. Consequently, the CPU 204 can detect a directional operation and a selection operation of the select button 132.

Further, the CPU 204 always scans a button switch matrix 209 to detect a manual operation of any other button switch of the remote commander 100 shown in FIG. 17.

The CPU 204 executes various processing in accordance with a program stored in a ROM 205 and suitably stores necessary data into a RAM (Random Access Memory) 206.

When an infrared ray signal is to be outputted, the CPU 204 drives a LED 208 via a LED driver 207 so that an infrared ray signal may be outputted from the LED 208.

For example, if a menu button 130 is depressed, then a corresponding infrared ray signal is emitted from the light emitting element 101 and received by a light receiving element (not shown) of the television receiver shown in FIG. 1. The signal is supplied to the CPU core 11, by which a display command for displaying a predetermined menu screen is placed into the display command register 18. The display command placed in the display command register 18 is supplied to the OSD device 5 via the output port register 19 and the bus line 25. The OSD device 5 generates an RGB signal corresponding to the menu screen and a control signal in response to the display command supplied thereto and supplies the signals to the switch 6. The switch 6 supplies the RGB signal from the OSD device 5 or a video signal from the video signal system block 3 to the CRT 4 changing over them at a predetermined timing in response to the control signal from the OSD device 5. As a result, a menu screen is displayed on the screen of the CRT 4 in a superposed condition with a program of an ordinary television broadcast as show in FIG. 3.

At first, the cursor is positioned at the "ITEM 1" which is the first item of the main menu and the "ITEM 1" is displayed highlighted while a sub menu corresponding to the "ITEM 1" is simultaneously displayed. If the select button 132 is manually operated, in this condition, in a downward direction in FIG. 19, then the cursor moves to the position of the "ITEM 2" as seen in FIG. 4A and the "ITEM 2" is highlighted displayed. Further, a sub menu corresponding to the "ITEM 2" is simultaneously displayed. Then, if the select button 132 is manually operated in the downward direction again, then the cursor moves to the position of the "ITEM 3" and the "ITEM 3" is displayed highlighted while a sub menu corresponding to the "ITEM 3" is simultaneously displayed. In this manner, by manually operating the select button 132, a sub menu corresponding to any item of the main menu can be displayed.

If, for example, the select button 132 is manually operated to position the cursor at the "ITEM 1" and then manually operated in the vertical direction, then the selection of the "ITEM 1" is selected. As a result, the cursor moves to the first item "ITEM 1-1" among items forming a sub menu corresponding to the "ITEM 1" and the "ITEM 1-1" is displayed highlighted. Here, by manually operating the select button 132 in an upward or downward direction, the cursor can be positioned at a desired one of the items of the sub menu. Then, by manually operating the select button 132 in the vertical direction, the selection of the highlighted displayed item can be selected.

Further, when the display of a sub menu is to be set to on (to be displayed) or off (not to be displayed), for example, the item "ITEM 4" of the main menu in FIG. 3 is determined as an item for changing over between on/off of a sub menu display, and the select button 132 is manually operated to move the cursor to the item "ITEM 4" and then manually operated in the vertical direction to indicate the selection of the "ITEM 4". Consequently, the display of the sub menu is turned off.

As a result, even if the cursor is positioned at one of the items of the main menu and the item is displayed highlighted, a sub menu corresponding to the item is not displayed. In order to set the display of a sub menu to on, operation similar to that described hereinabove is performed so that the display of the sub menu can be set to on.

By setting the display of a sub menu to off, possible obstruction of it to enjoyment of a program of a television broadcast displayed on the screen can be minimized. Further, to a user who understands the menu structure well, elimination of an unnecessary display can improve the convenience for use.

FIG. 21 shows in schematic view another remote commander for a television receiver to which the present invention is applied. The present remote commander is a modification to and is basically common with the remote commander described hereinabove with reference to FIG. 17 in terms of the arrangement of buttons, the internal construction and the operation, and overlapping description thereof is omitted here to avoid redundancy. The present remote commander is different from the remote commander of FIG. 17 only in that it additionally includes a sub menu button 133 (lower menu display instruction means) for exclusive use for turning the display of a sub menu on or off. A user can set the display of a sub menu to on or off by depressing the sub menu button 133.

It is to be noted that, while the menu system in any of the television receivers of the embodiments described hereinabove includes two hierarchies of the main menu and sub menus, it may otherwise include an arbitrary number of hierarchies equal to or greater than 3. In this instance, menus of all hierarchies may be displayed on a screen or menus of only a predetermined number of ones of the hierarchies may be displayed on a screen.

Further, while the main menu in any of the television receivers of the embodiments described hereinabove is displayed on the left side portion of the screen while a sub menu is displayed on the right side portion of the screen, they may otherwise be displayed at other arbitrary positions.

Further, while, in any of the television receivers of the embodiments described above, items forming the main menu or a sub menu are arranged in a vertical column, they may otherwise be arranged in a horizontal row.

Further, while a sub menu on any of the television screens of the embodiments described above is displayed in the form of characters, it may otherwise be displayed in the form of button icons or the like.

Further, while the pointer displayed on any screen shown in the drawings is shown having the shape of a finger, it may have the shape of an arrow mark or may have any other arbitrary shape.

Having now fully described the invention, it will be apparent to one of ordinary skill in the art that many changes and modifications can be made thereto without departing from the spirit and scope of the invention as set forth herein.

What is claimed is:

1. A function selection method for a television receiver comprising the steps of:

displaying a first level of a hierarchical menu in a first region of a screen of said television receiver, wherein a plurality of selection items corresponding to functions of said television receiver are displayed;

designating one of said plurality of selection items from said first level of said hierarchical menu displayed on said screen of said television receiver;

displaying a subordinate level of said hierarchical menu in a second region of said screen, wherein a plurality of control items corresponding to said designated selection item are displayed;

selecting said designated selection item of said first level of said hierarchical menu;

selecting one of said plurality of control items from said subordinate level of said hierarchical menu; and

modifying said selected control item, whereby said functions of said television receiver corresponding to said designated selection item is controlled by modifying said selected control item.

2. The function selection method according to claim 1 wherein a number of levels of hierarchy of said hierarchical menu is equal to or greater than 2.

3. A function selection method for a television receiver comprising the steps of:

displaying a first level of a hierarchical menu indicating a plurality of selection items corresponding to functions of said television receiver in a first region of a screen of said television receiver;

designating one of said plurality of selection items from said first level of said hierarchical menu displayed on said screen of said television receiver;

selecting said designated selection item;

displaying a subordinate menu in a second region of said screen of said television receiver indicating further selection items corresponding to a further set of functions of said television receiver related to the designated selection item; and

selecting one of the selection items from said subordinate menu, whereby said further set of selection items is used to control said further set of functions of said television receiver.

4. The function selection method according to claim 3, wherein said number of the hierarchies of said hierarchical menu is equal to or greater than 2.

5. A television receiver, comprising:

menu display means for displaying selection items of a first level of a hierarchical menu which includes a plurality of selection items corresponding to functions of said television receiver in a first region of a screen of said television receiver;

designation means for designating one of said selection items of said first hierarchical level of the menu displayed by said menu display means;

subordinate menu display means for displaying a subordinate hierarchical level of said menu which includes a plurality of control items for controlling a function corresponding to said designated selection item of said first hierarchical level in a second region of said screen of said television receiver;

first selection means for selecting said selection item designated by said designation means;

second selection means for selecting one of said plurality of control items from said subordinate menu related to said selection item selected by said first selection means; and

modifying means for modifying said control item, whereby said functions of said television receiver corresponding to said selected selection item is modified.

6. The television receiver according to claim 5 wherein a number of hierarchical levels of said menu is equal to or greater than 2.

7. The television receiver according to claim 5 further comprising a setting means responsive to said menu display means for preventing said subordinate menu display means from displaying said subordinate hierarchical level of said menu.

8. A remote commander for a television receiver comprising:

menu display instruction means for causing said television receiver to display a first level of a hierarchical menu in a first region of a screen of said television receiver, wherein selection items of said first level of said hierarchical menu correspond to functions of said television receiver and, wherein at least one subordinate hierarchical level of said menu corresponds to control of said functions of said television receiver;

designation means for causing said television receiver to designate one of said selection items of said first hierarchical level of said menu displayed by said television receiver in response to said menu display instruction means;

subordinate menu display instruction means for causing said television receiver to display said subordinate hierarchical level in a second region of said screen of said television receiver while said selection items of said first hierarchical level of said menu are displayed in said first region of said screen in response to the instruction of said menu display instruction means, wherein said control functions of said subordinate level of said menu correspond to designated selection items of said first level of said menu;

first selection means for selecting said selection item designated by said designation means; and

second selection means for selecting one of said control functions of said subordinate menu.

9. The remote commander for a television receiver according to claim 8 wherein a number of the hierarchies of said menu is equal to or greater than 2.

10. The function selection method according to claim 1 wherein said first and second screen regions do not overlap.

11. The function selection method according to claim 3 wherein said first and second screen regions do not overlap.

12. The television receiver according to claim 5 wherein said first and second screen regions do not overlap.

13. The remote commander according to claim 8 wherein said first and second screen regions do not overlap.

* * * * *

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EXHIBIT F

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US006111614A

United States Patent [19]

Mugura et al.

[11] Patent Number: 6,111,614

[45] Date of Patent: Aug. 29, 2000

[54] METHOD AND APPARATUS FOR DISPLAYING AN ELECTRONIC MENU HAVING COMPONENTS WITH DIFFERING LEVELS OF TRANSPARENCY

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[73] Assignees: **Sony Corporation**, Tokyo, Japan; **Sony Electronics, Inc.**, Park Ridge, N.J.

[21] Appl. No.: **08/953,032**

[22] Filed: **Oct. 17, 1997**

[51] **Int. Cl.**[7] **H04N 7/00**; H04N 9/45

[52] **U.S. Cl.** **348/569**; 345/146; 345/113; 345/339; 348/8; 348/10; 348/563; 348/906

[58] **Field of Search** 345/146, 339, 345/352, 340, 113, 114, 327, 345, 1.2; 348/563, 564, 569, 570, 734, 906, 8, 10, 553, 7, 9, 13

[56] **References Cited**

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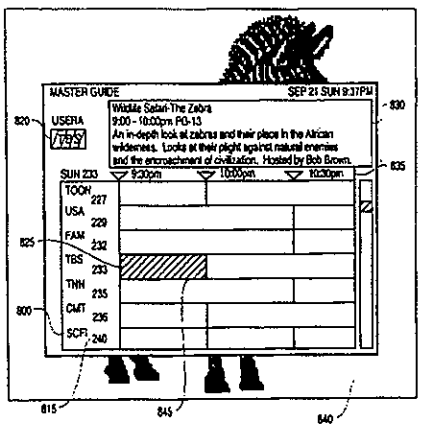
Primary Examiner—Mark R. Powell
Assistant Examiner—Wesner Sajous
Attorney, Agent, or Firm—Blakely, Sokoloff, Taylor & Zafman LLP

[57] **ABSTRACT**

A method and apparatus for displaying an electronic menu having components with differing levels of transparency are provided. A multiple channel broadcasting system generates an on-screen menu display for enabling a user to operate different functions of the system. The broadcasting system generates an electronic menu display that comprises a number of components, alphanumeric characters, and icons displayed on a background. The components, alphanumeric characters, and icons identify different functions of the system. The broadcast system applies different levels of transparency to the different components such that the number of opaque components is minimized. The broadcast system then superimposes the electronic menu display over a program broadcast on a screen. As the opaque components are minimized, the obstruction of the broadcast by the electronic menu display is minimized.

19 Claims, 29 Drawing Sheets



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Movies Guide					Thurs 12/16/94 1:54PM	
	12:30PM	1:00PM	1:30PM	2:00PM		
OTV 149	Seduce Me: Pamela Principle 2			Seduce Me: Pamela...		
MTV 150	Top Rap Videos	Music of the '70s				
C TV 151	Cooking with Linus	Comedy Club				
OTV 154	The Ref		The Ref			
OTV 155	Star Trek	The Chase				
STV 156	Wildlife Safari		Ancient Civilizations			
	Themes	Sports	Other	All	Exit	

FIG. 1 (PRIOR ART)

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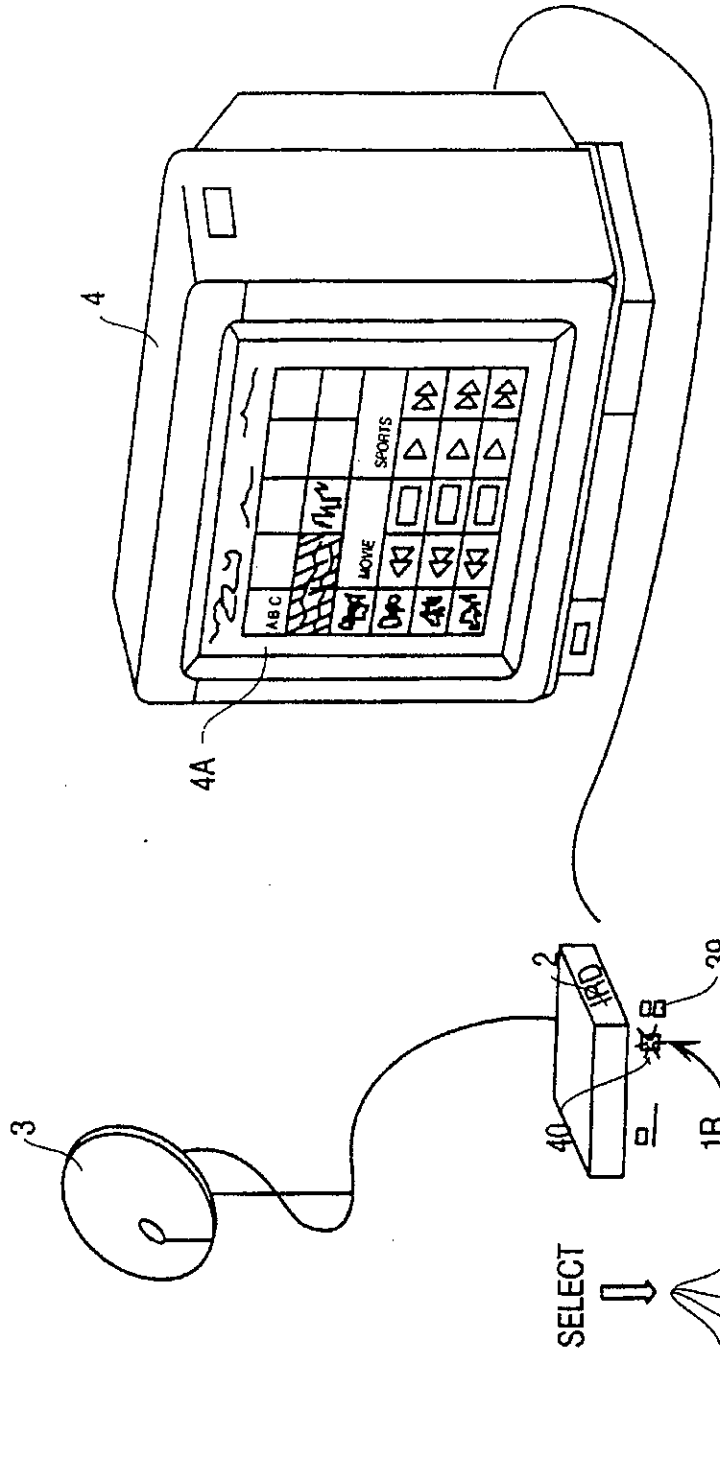

FIG. 2

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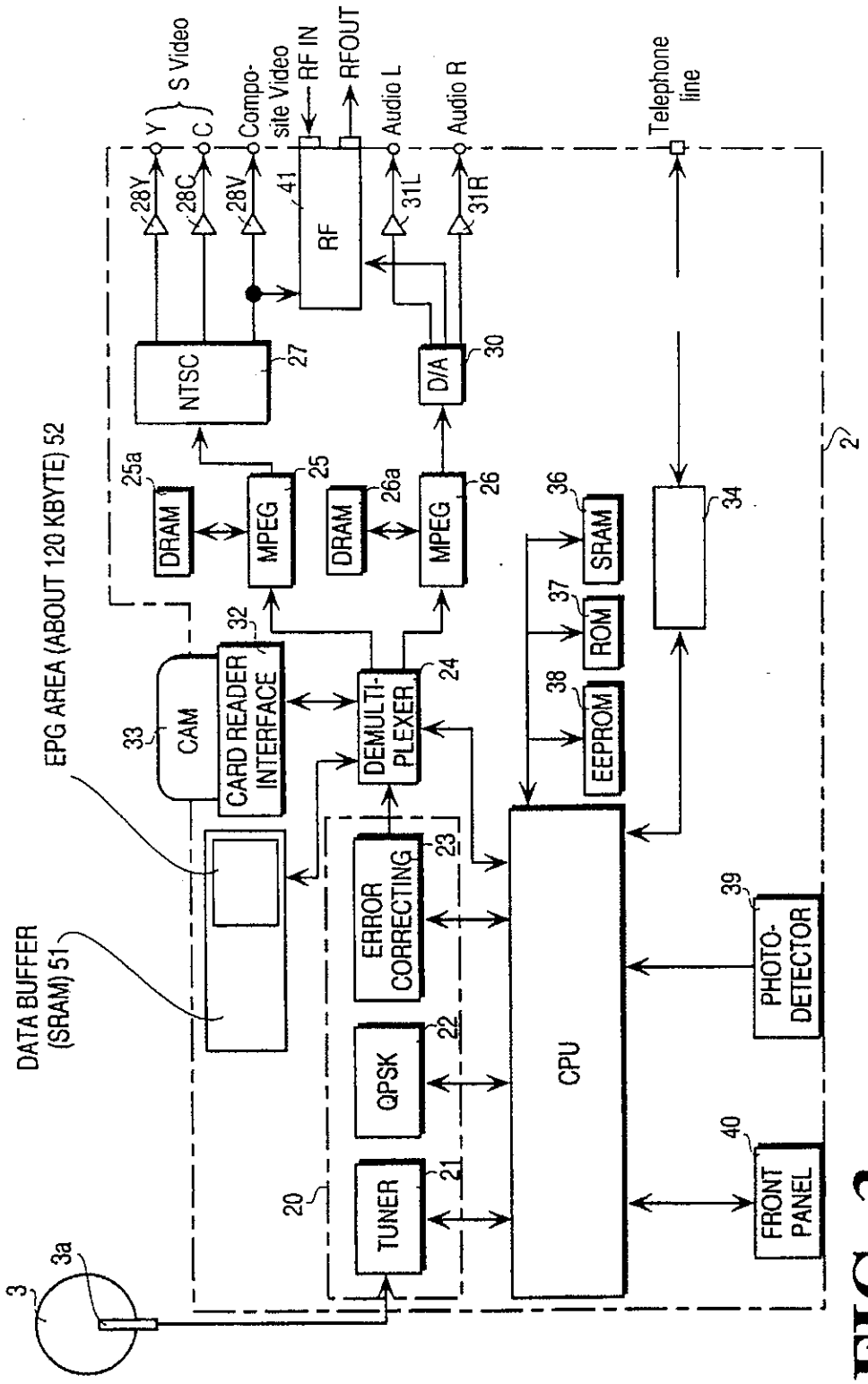

FIG. 3

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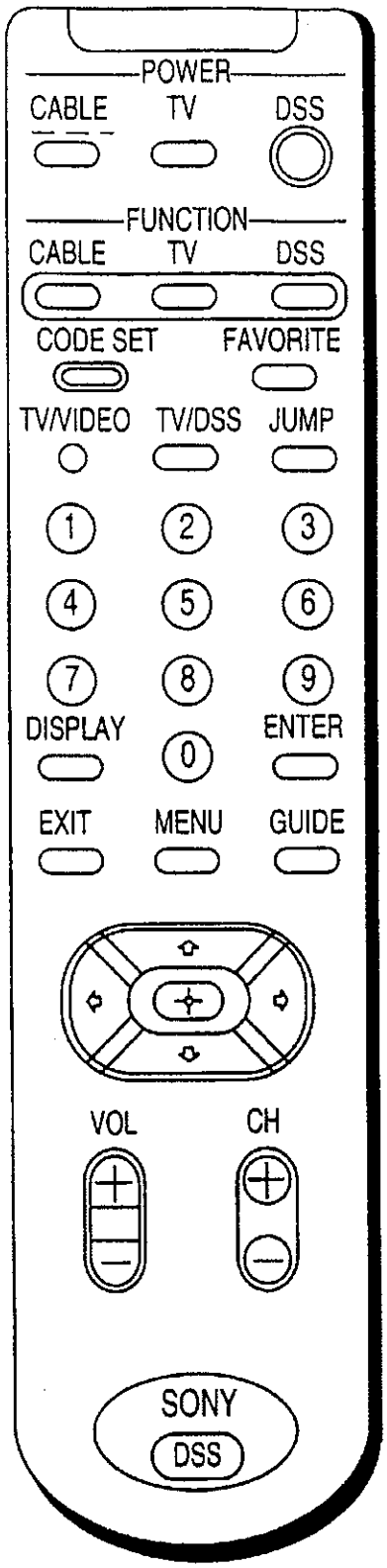

FIG. 4

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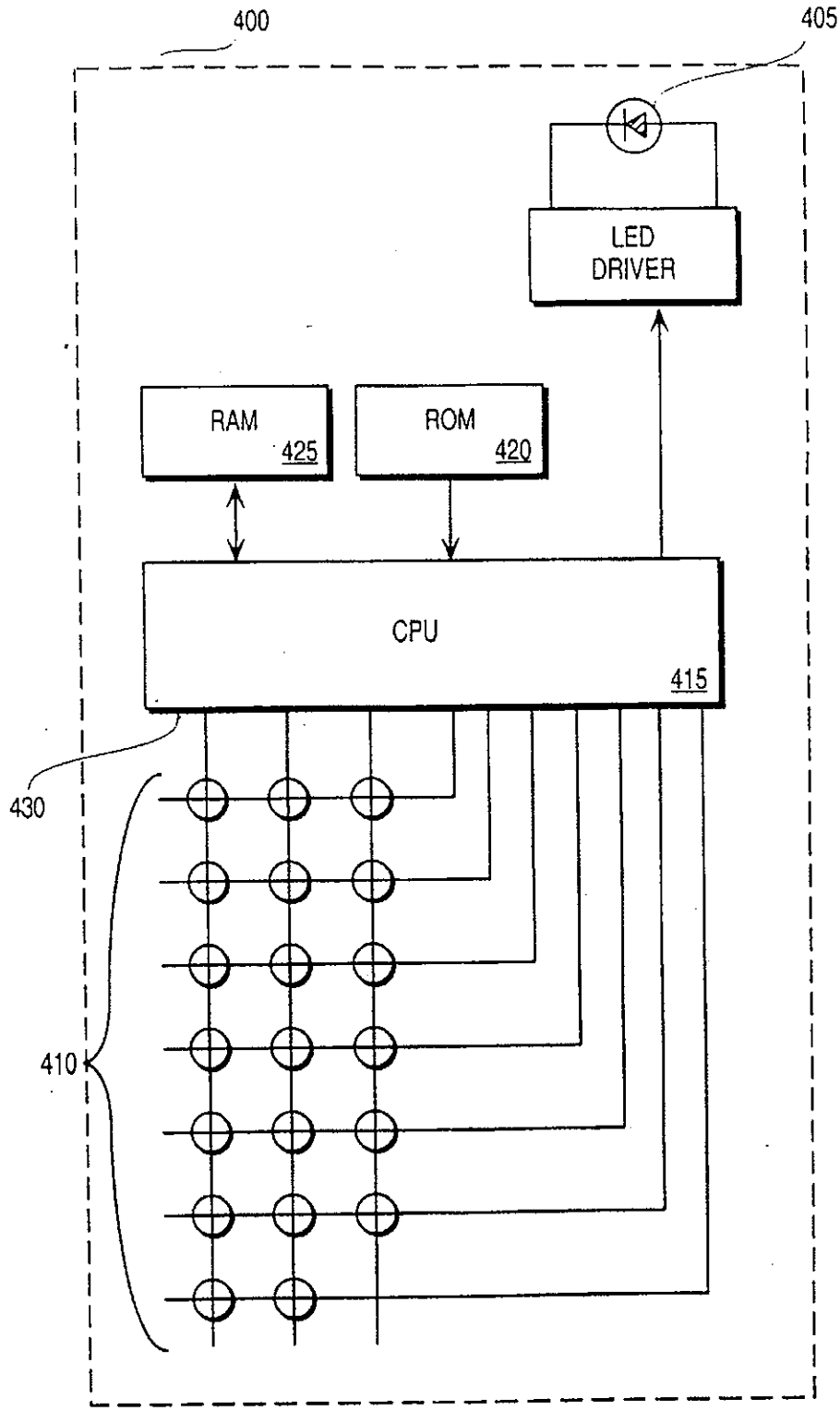

FIG. 5

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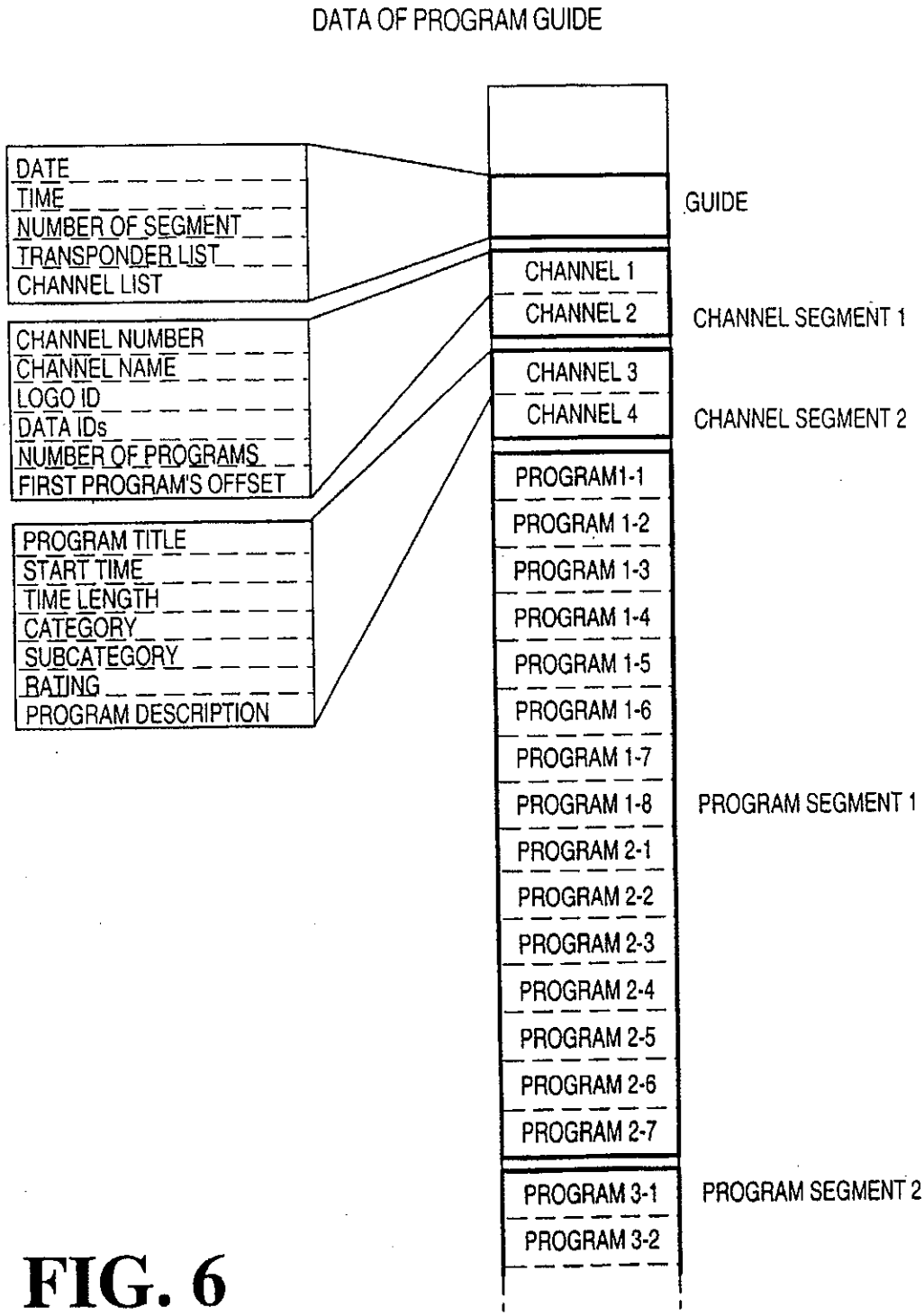

FIG. 6

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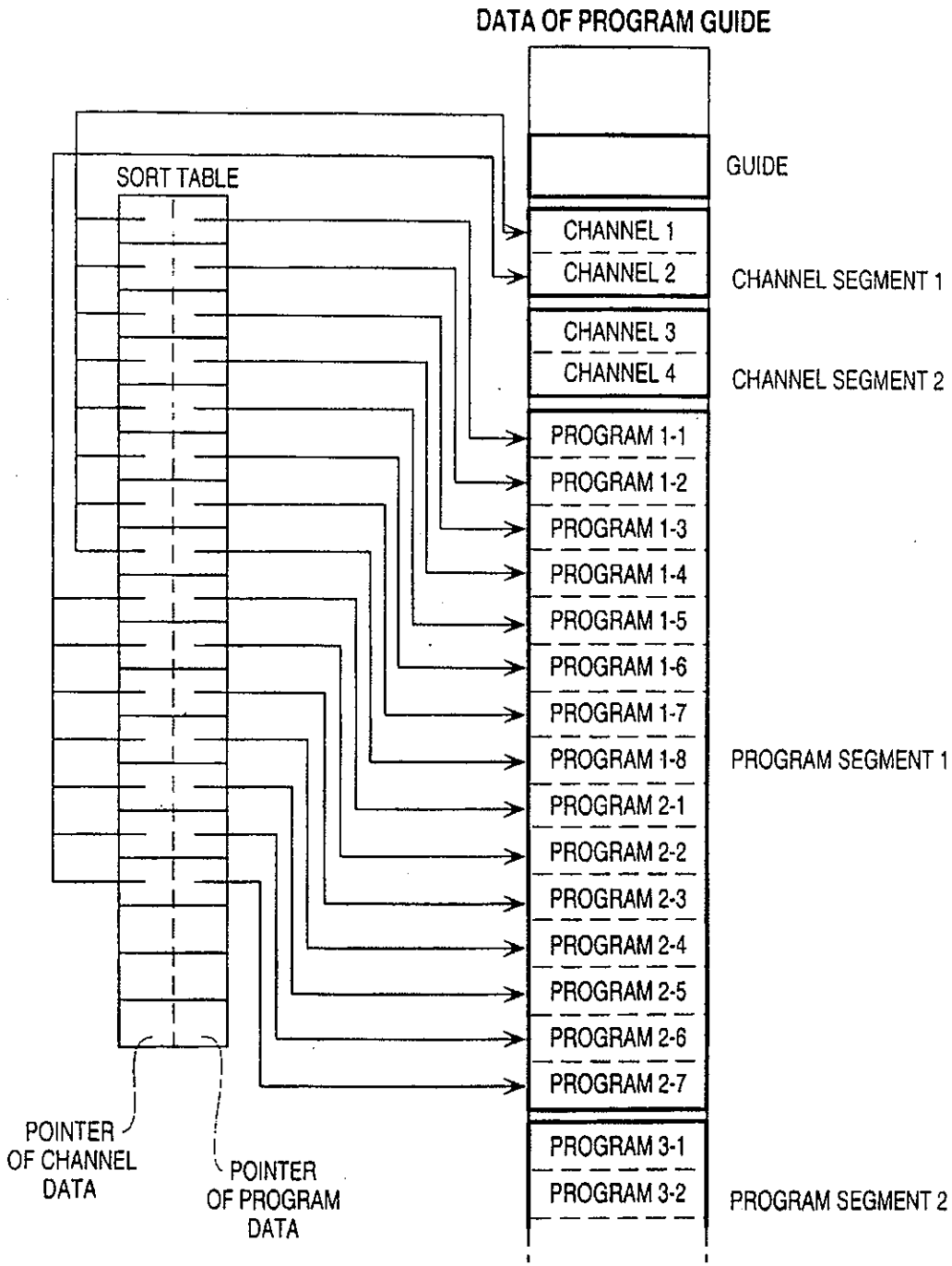

FIG. 7

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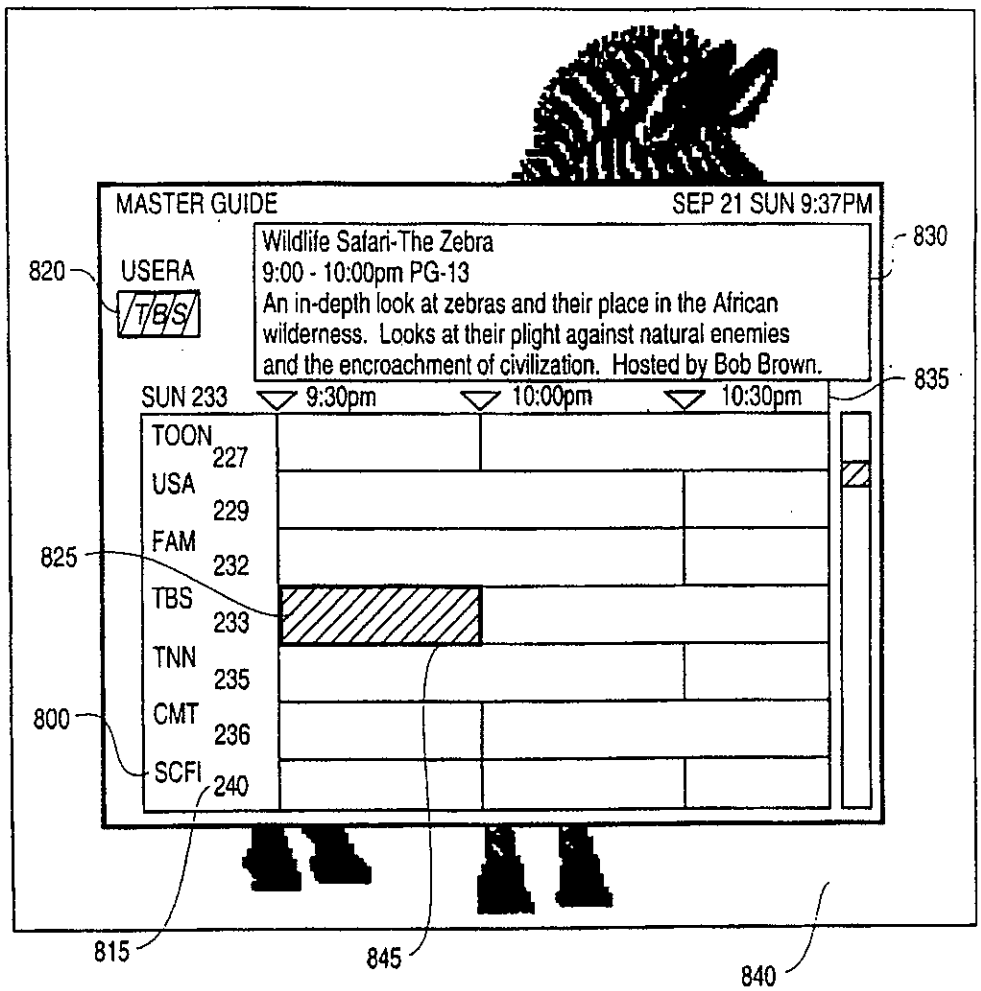

FIG. 8

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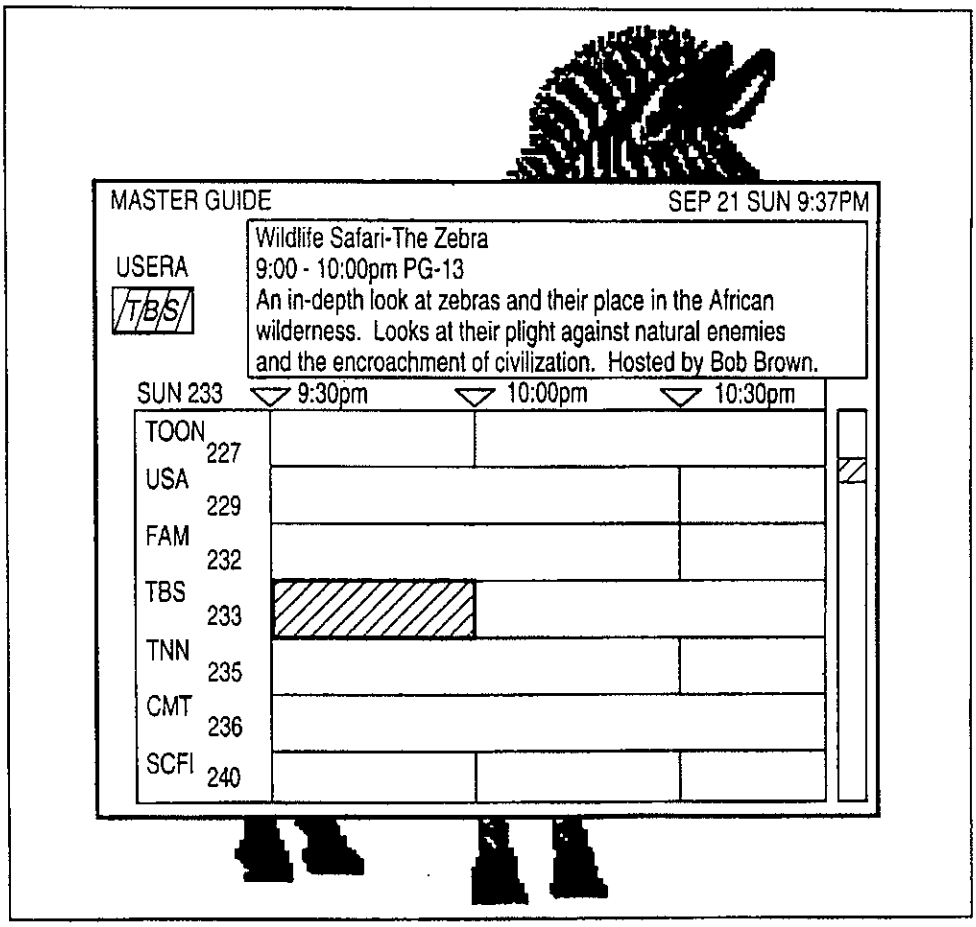

FIG. 9A

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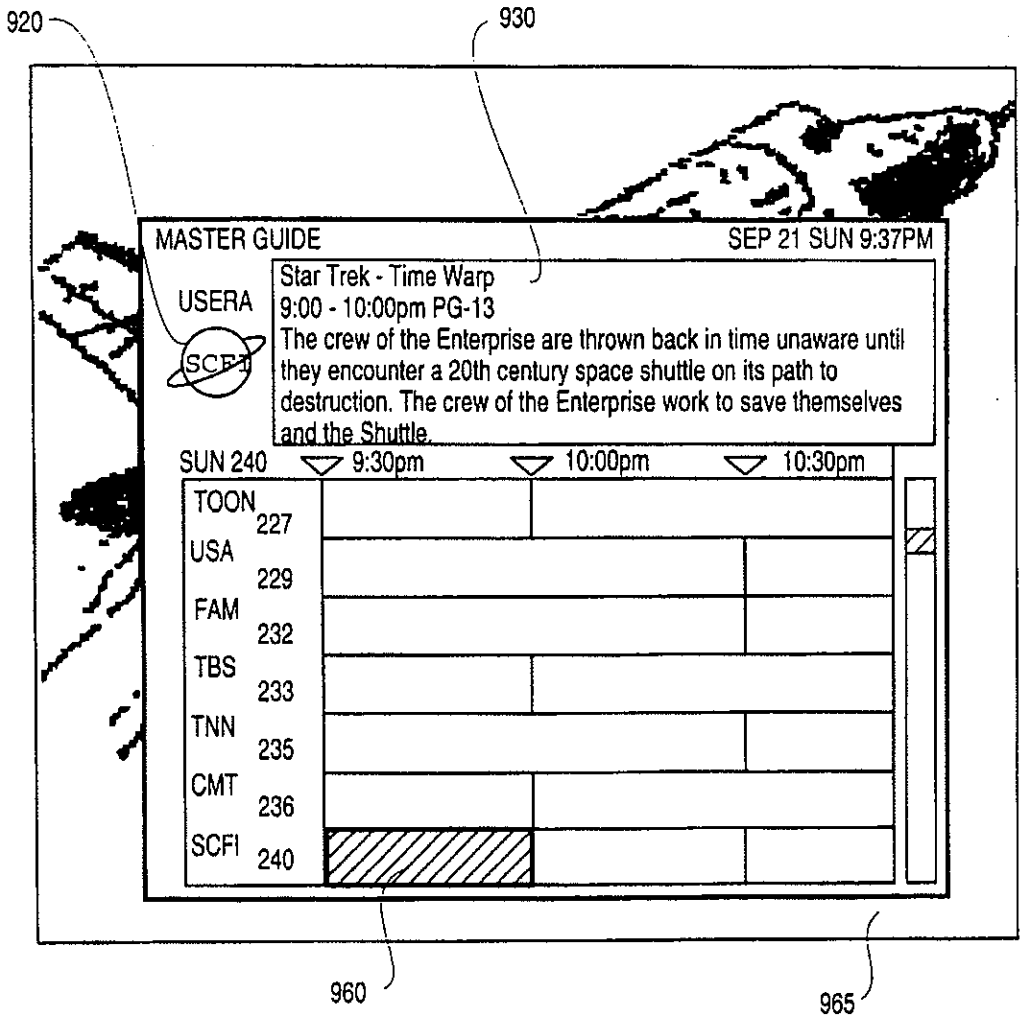

FIG. 9B

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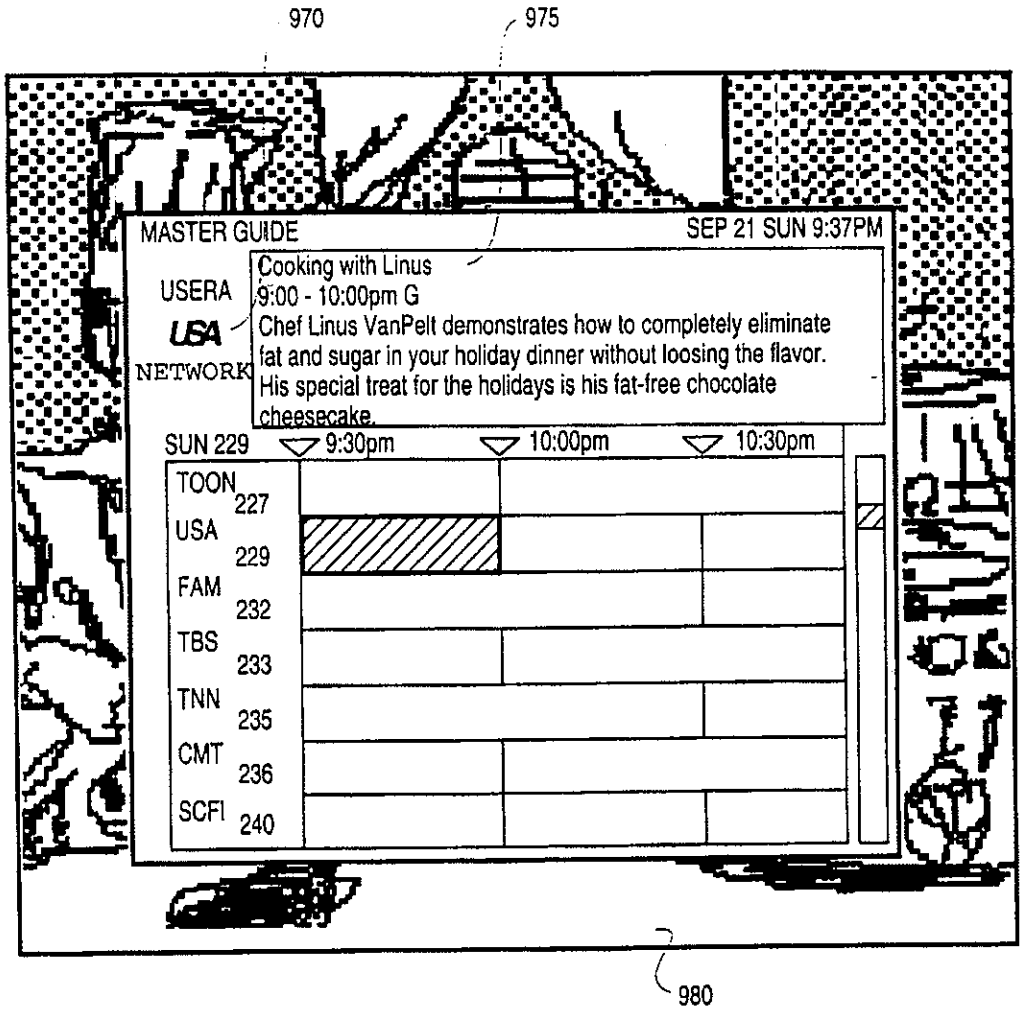

FIG. 9C

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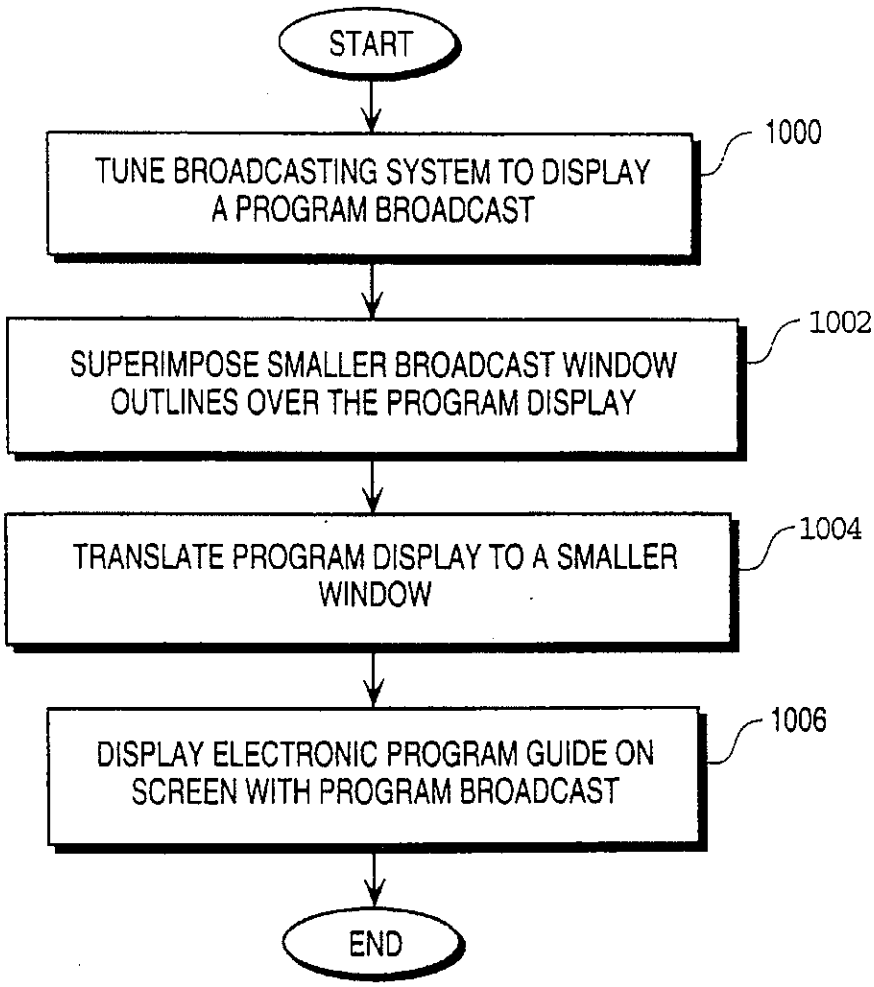

FIG. 10

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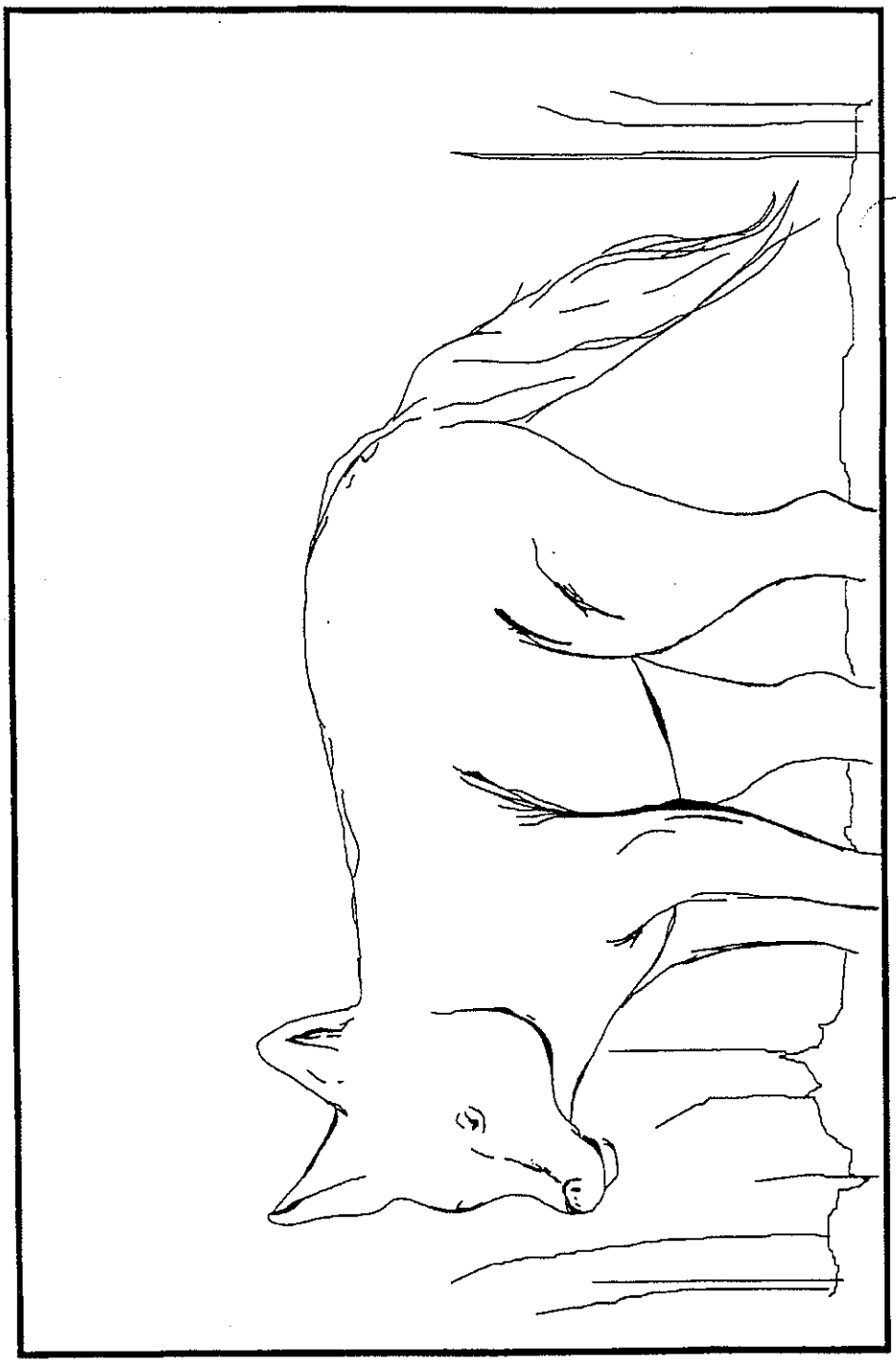

FIG. 11

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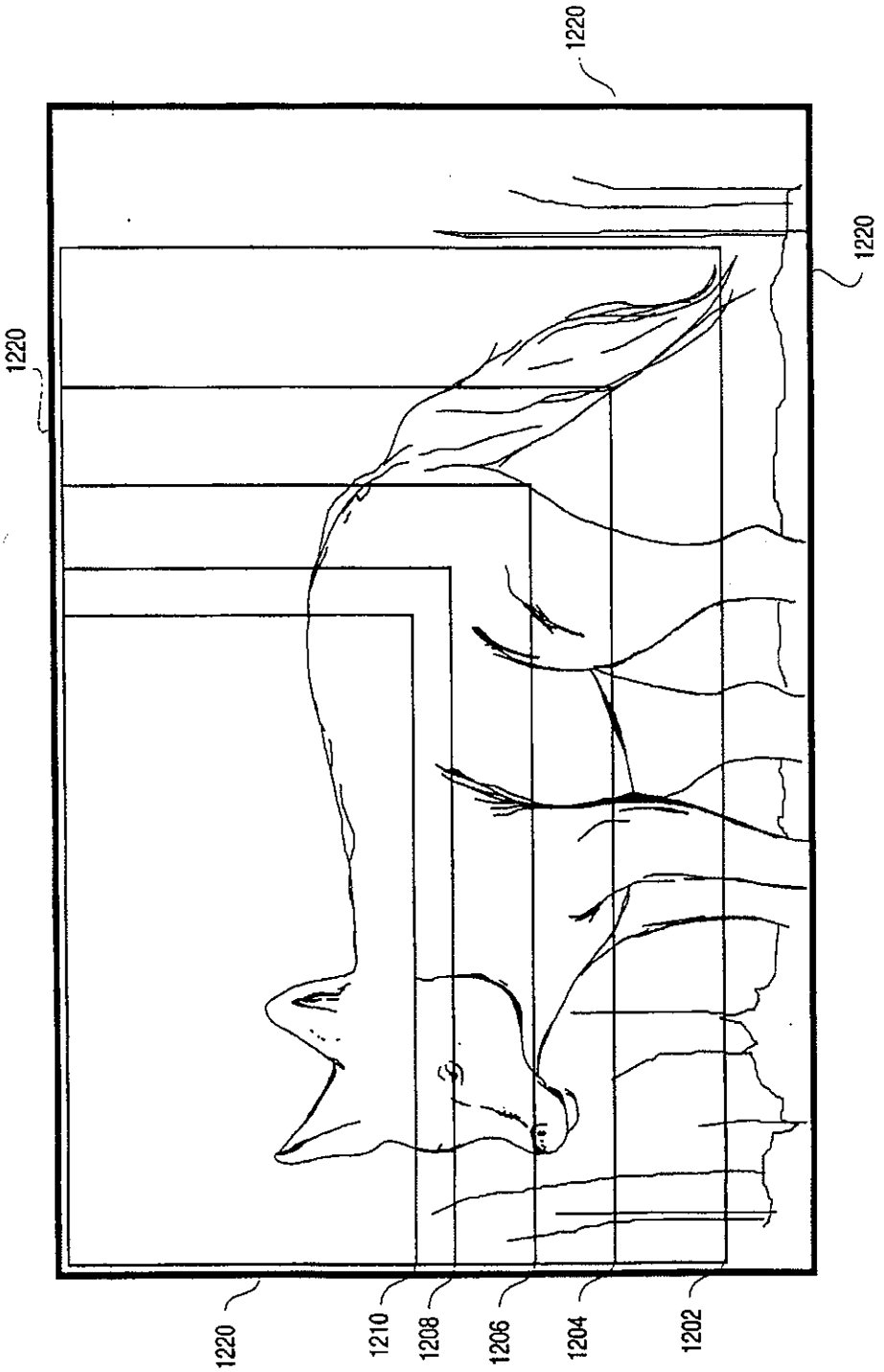

FIG. 12

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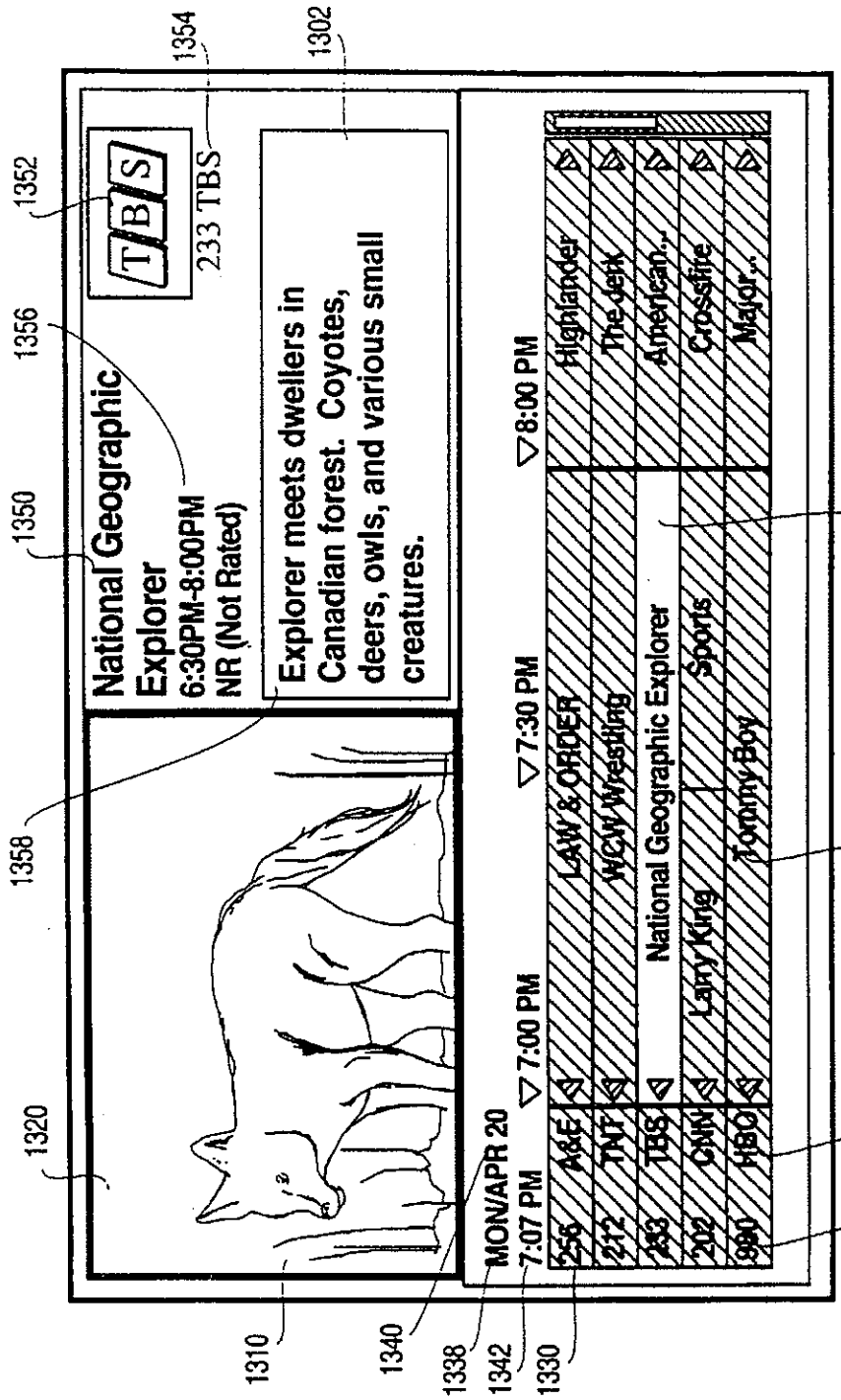

FIG. 13

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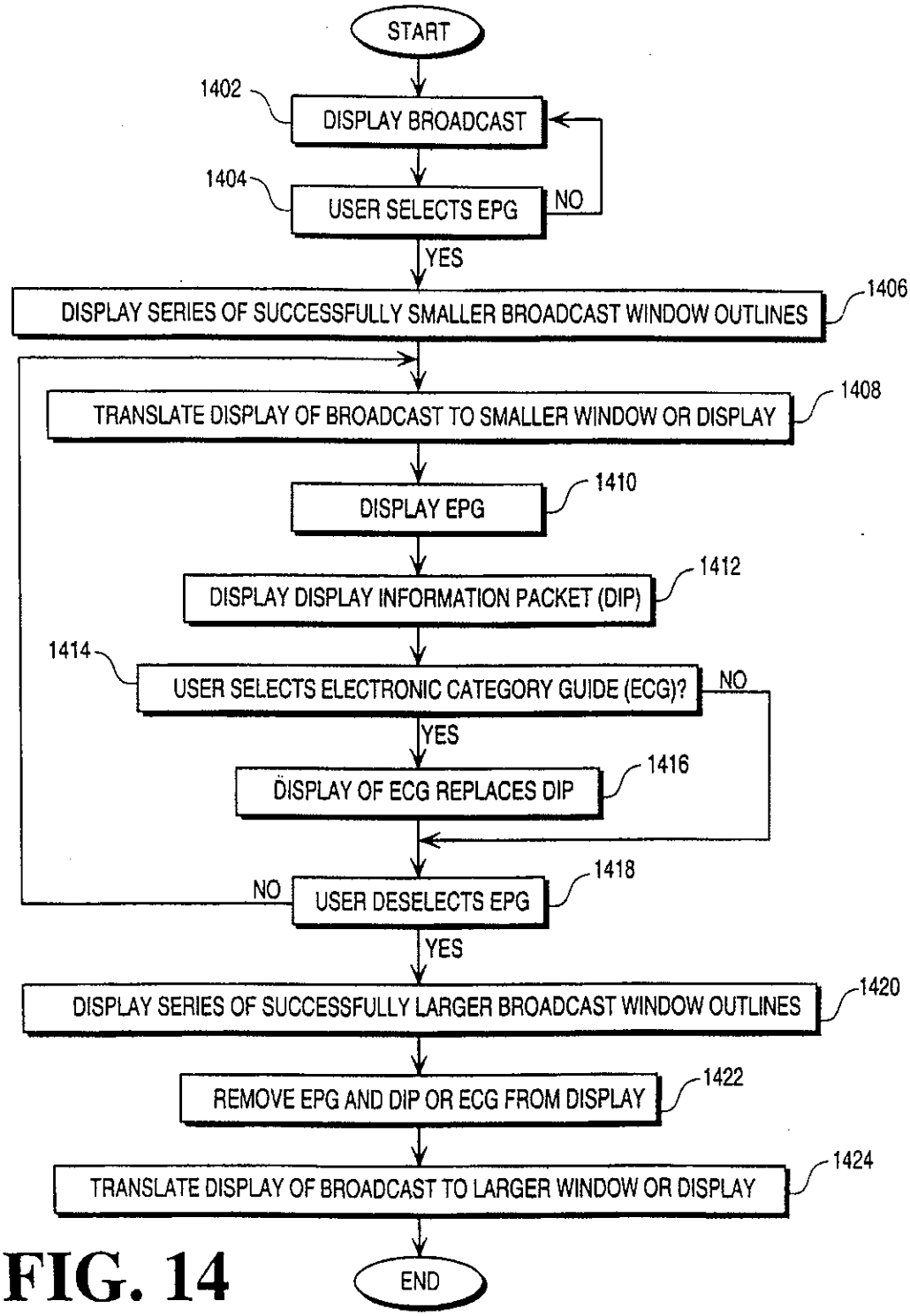

FIG. 14

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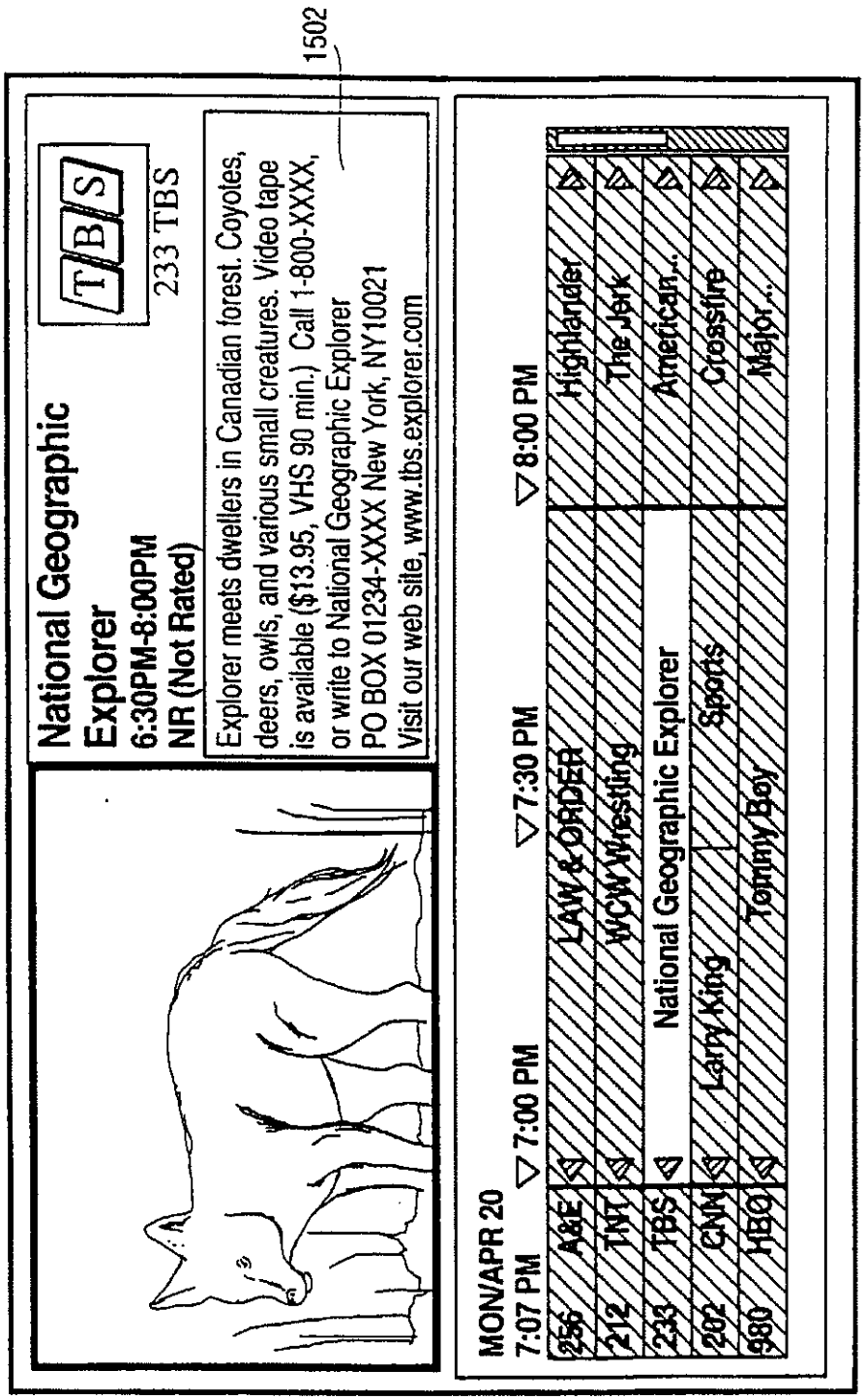

FIG. 15

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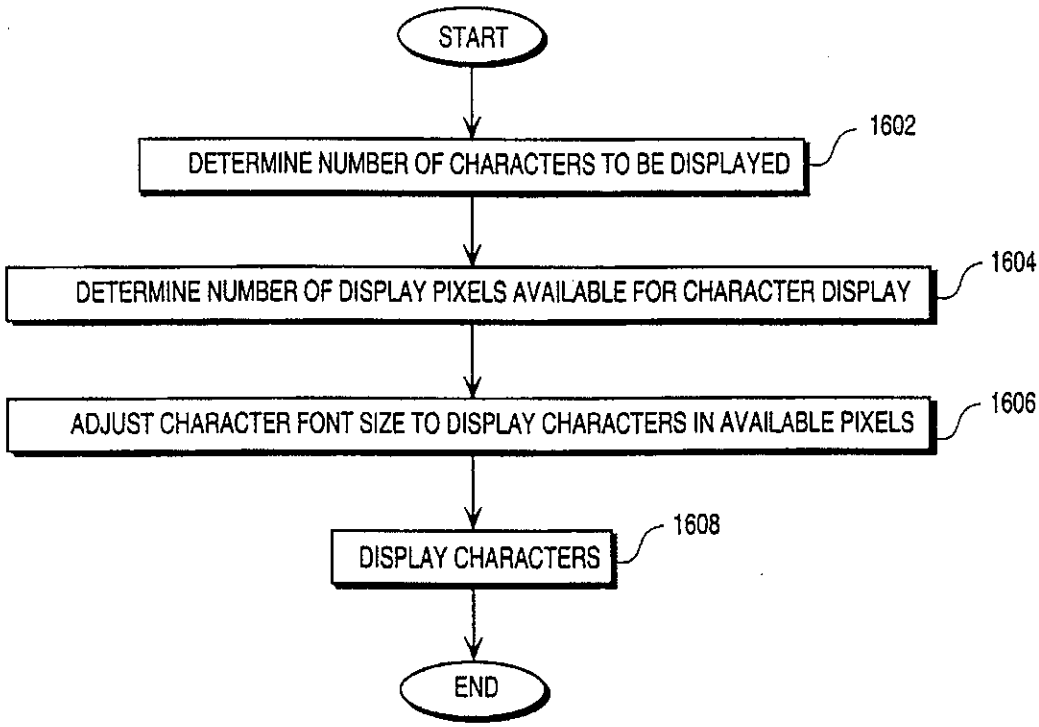

FIG. 16

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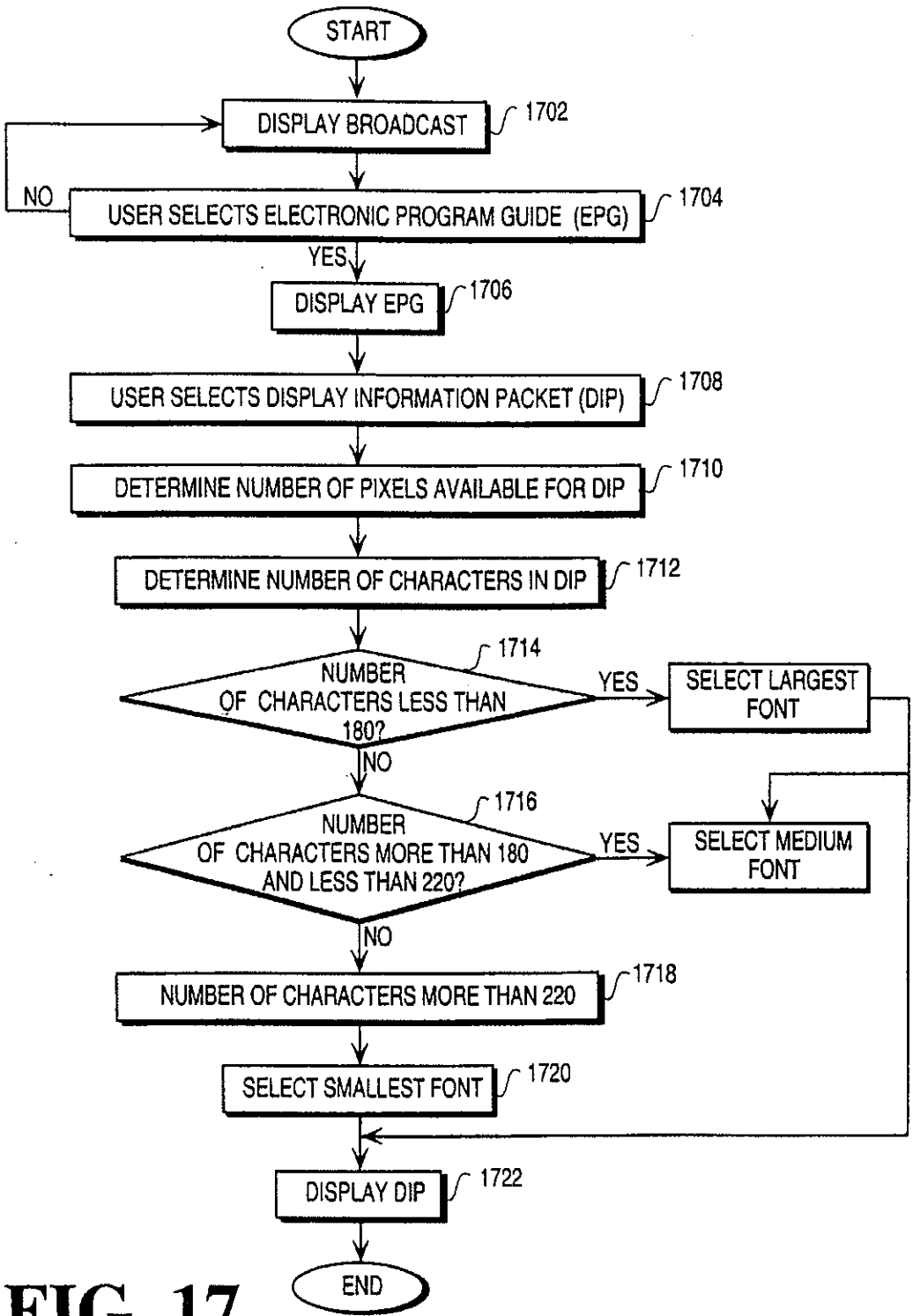

FIG. 17

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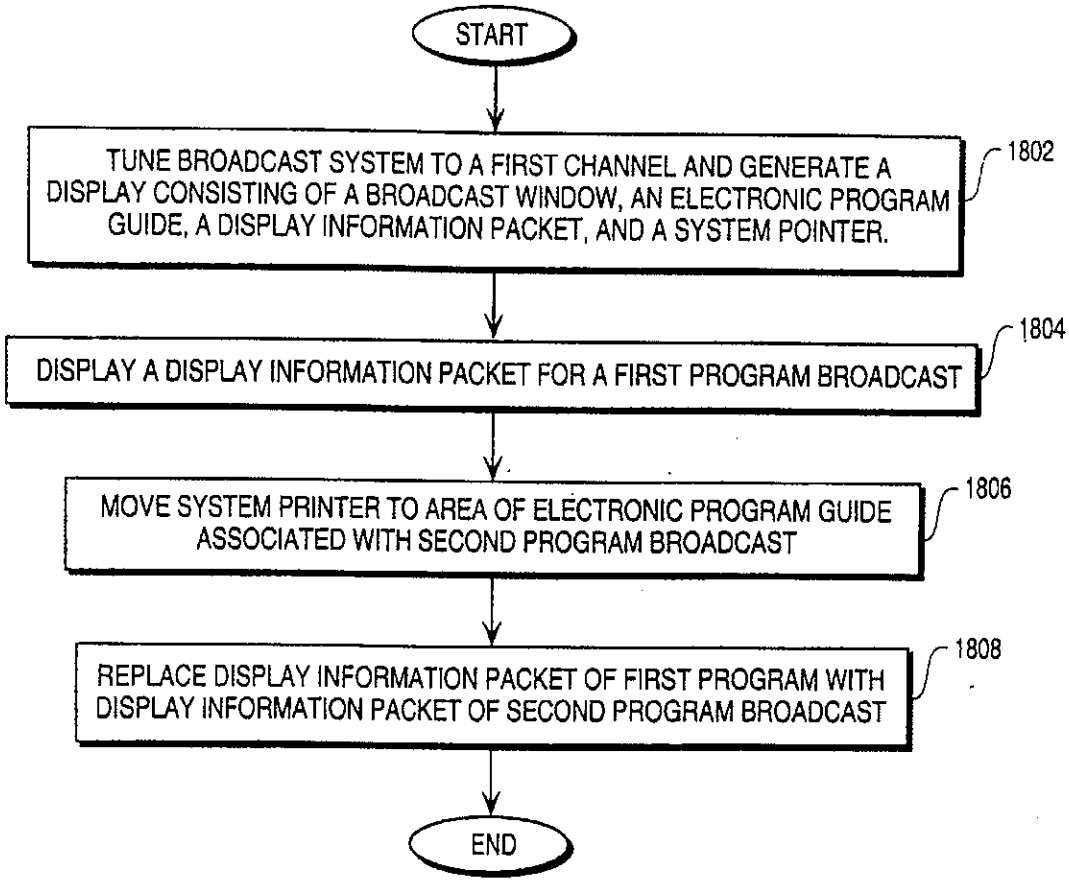

FIG. 18

EXHIBIT F
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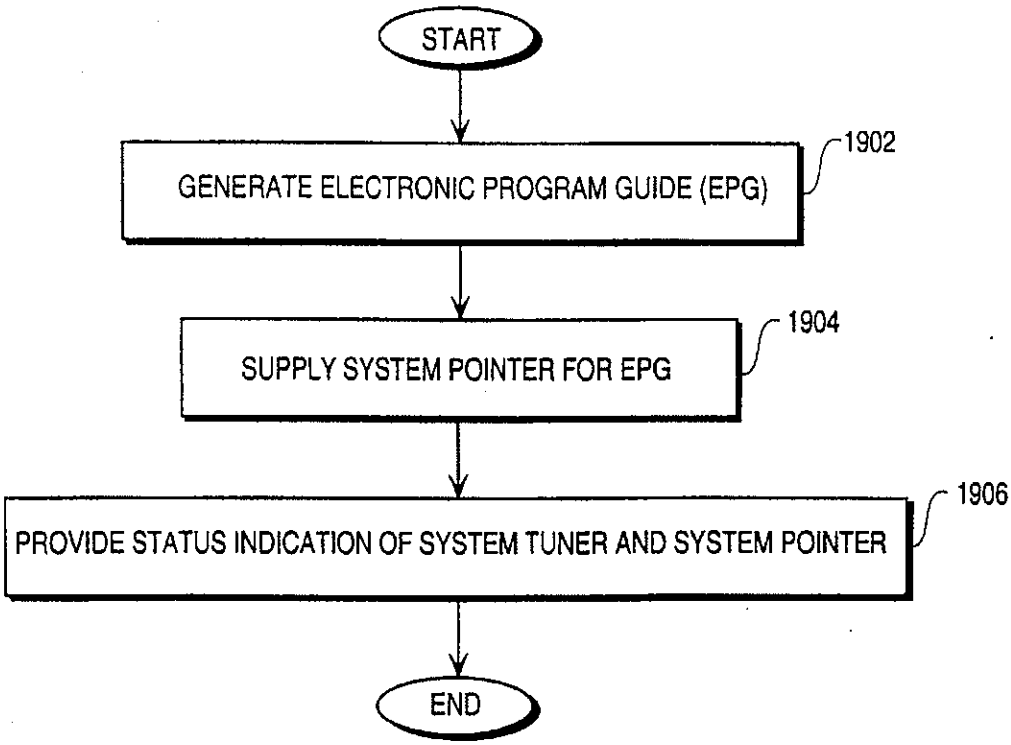

FIG. 19

EXHIBIT F
PAGE 204

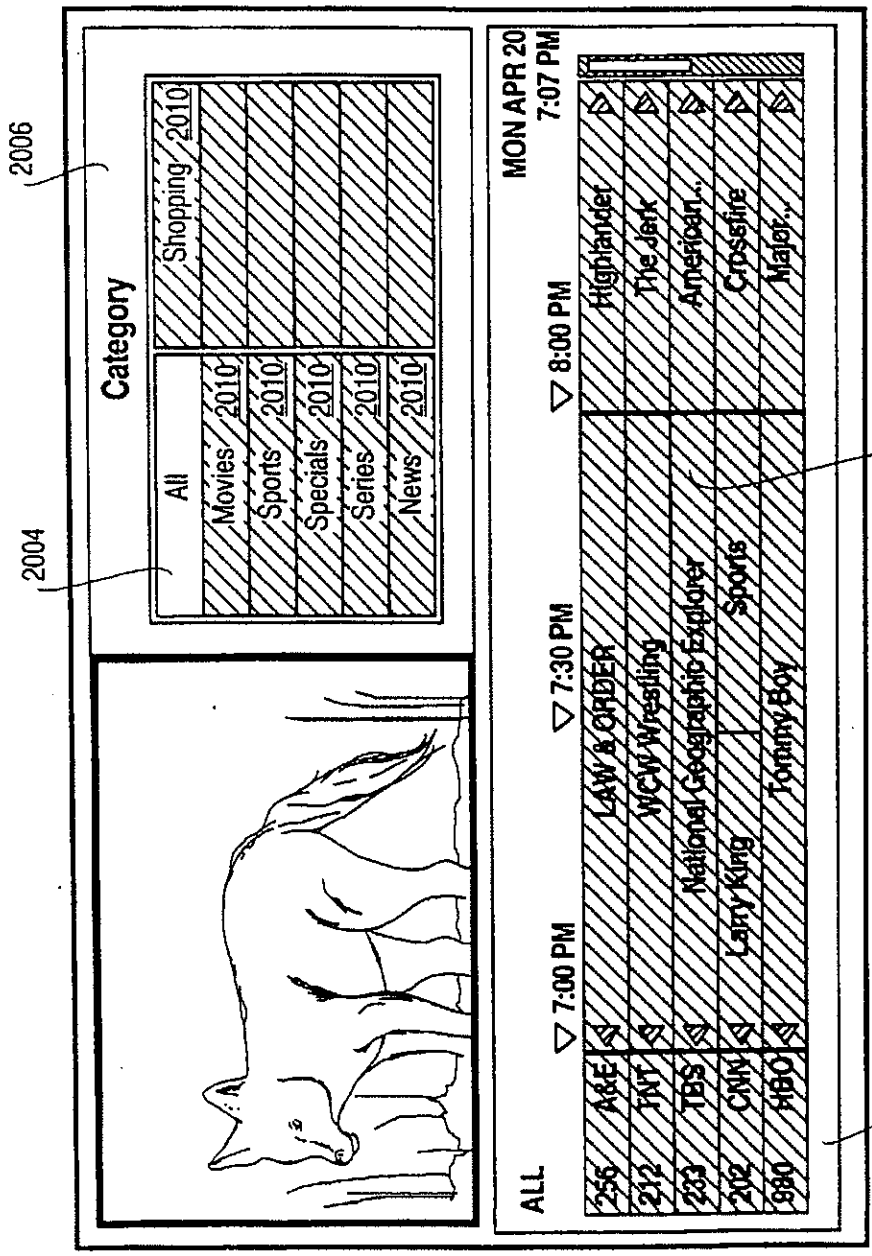

FIG. 20

EXHIBIT F
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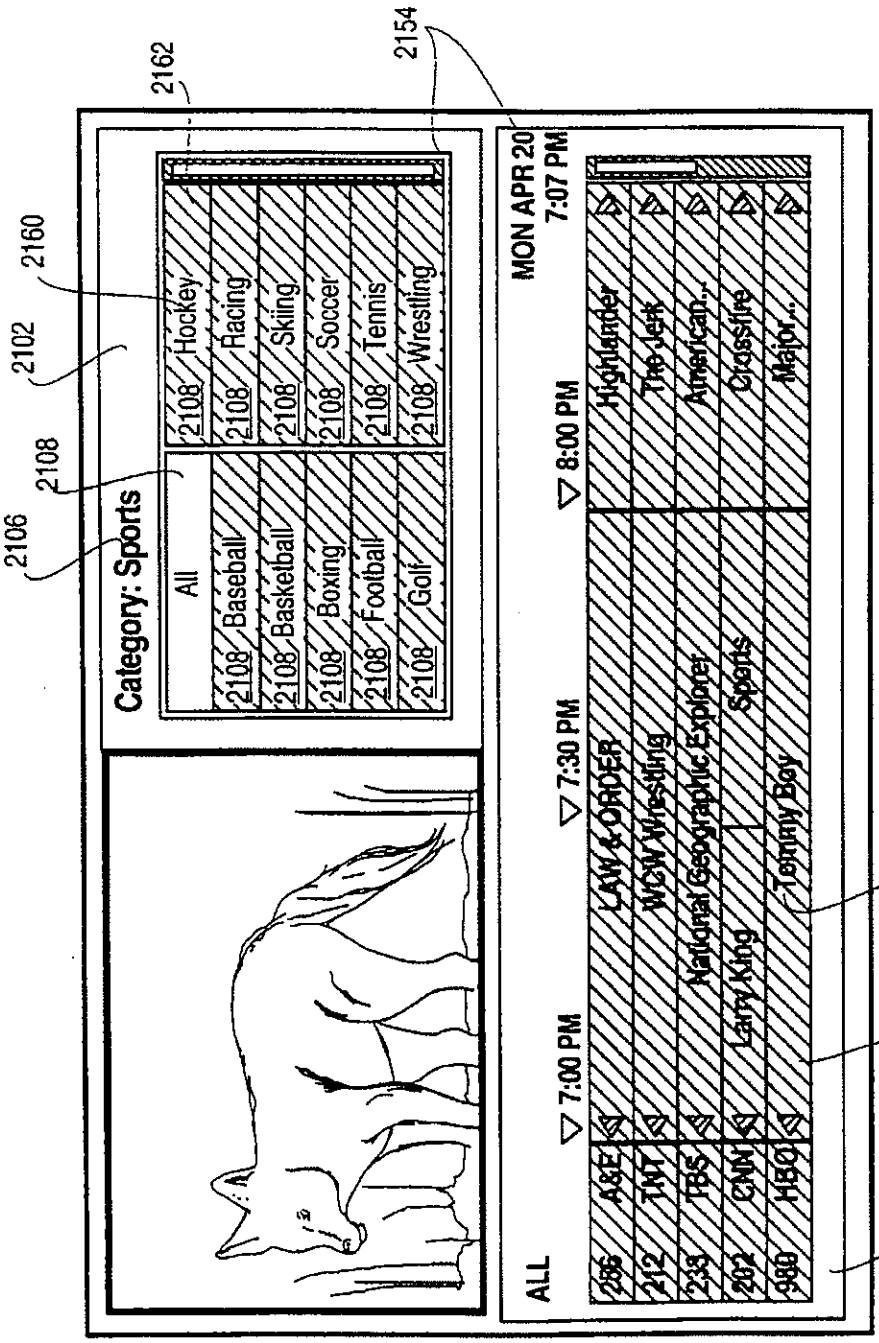

FIG. 21

EXHIBIT F
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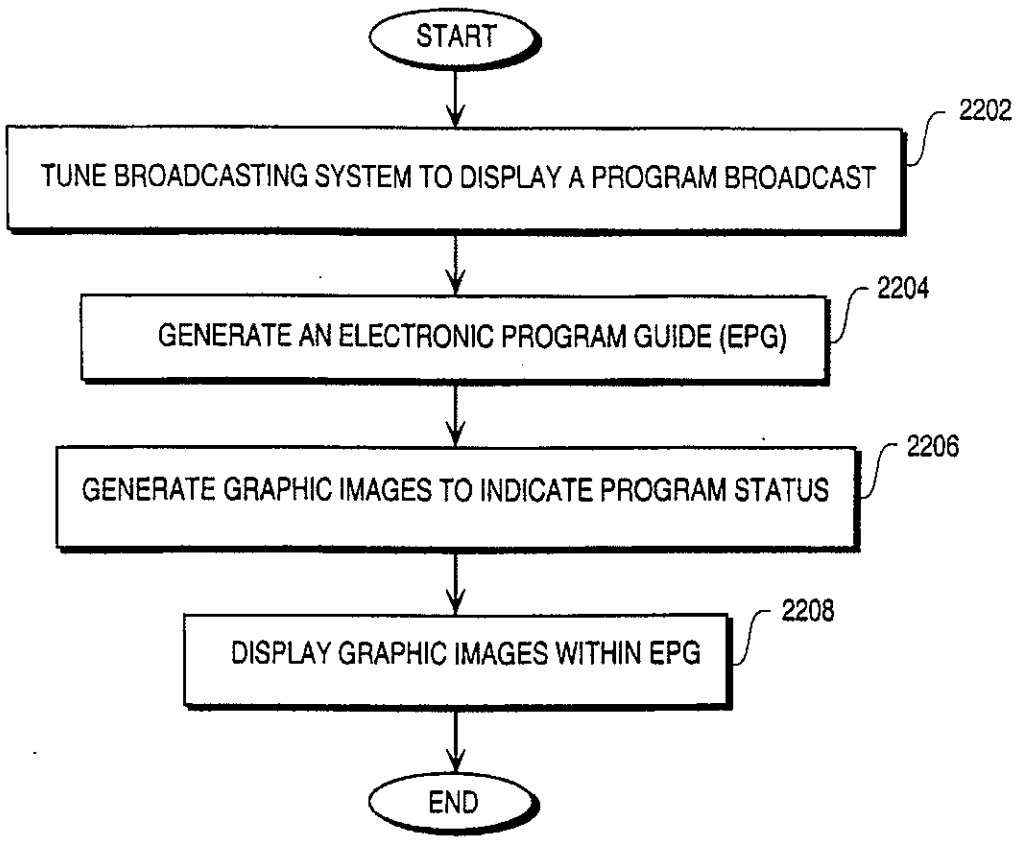

FIG. 22

EXHIBIT 6
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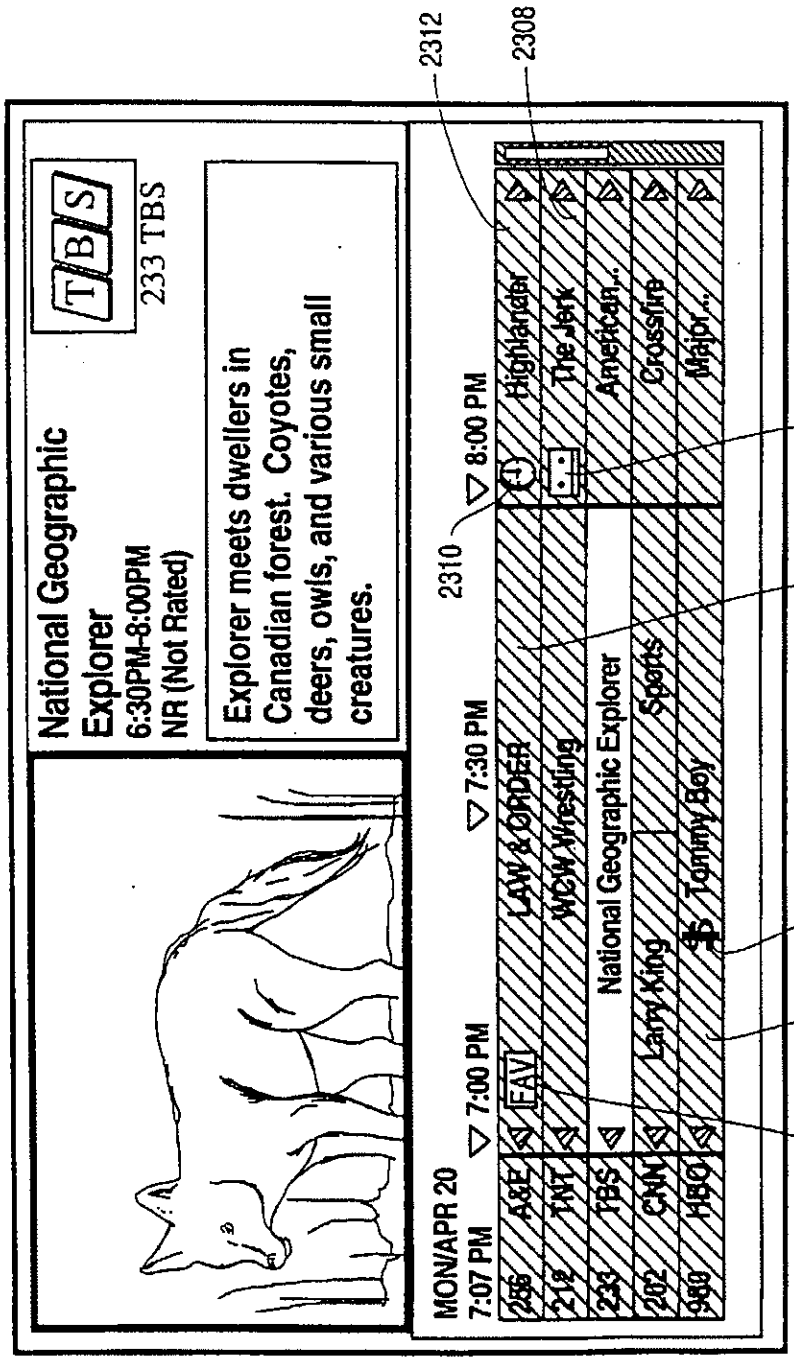

FIG. 23

EXHIBIT F
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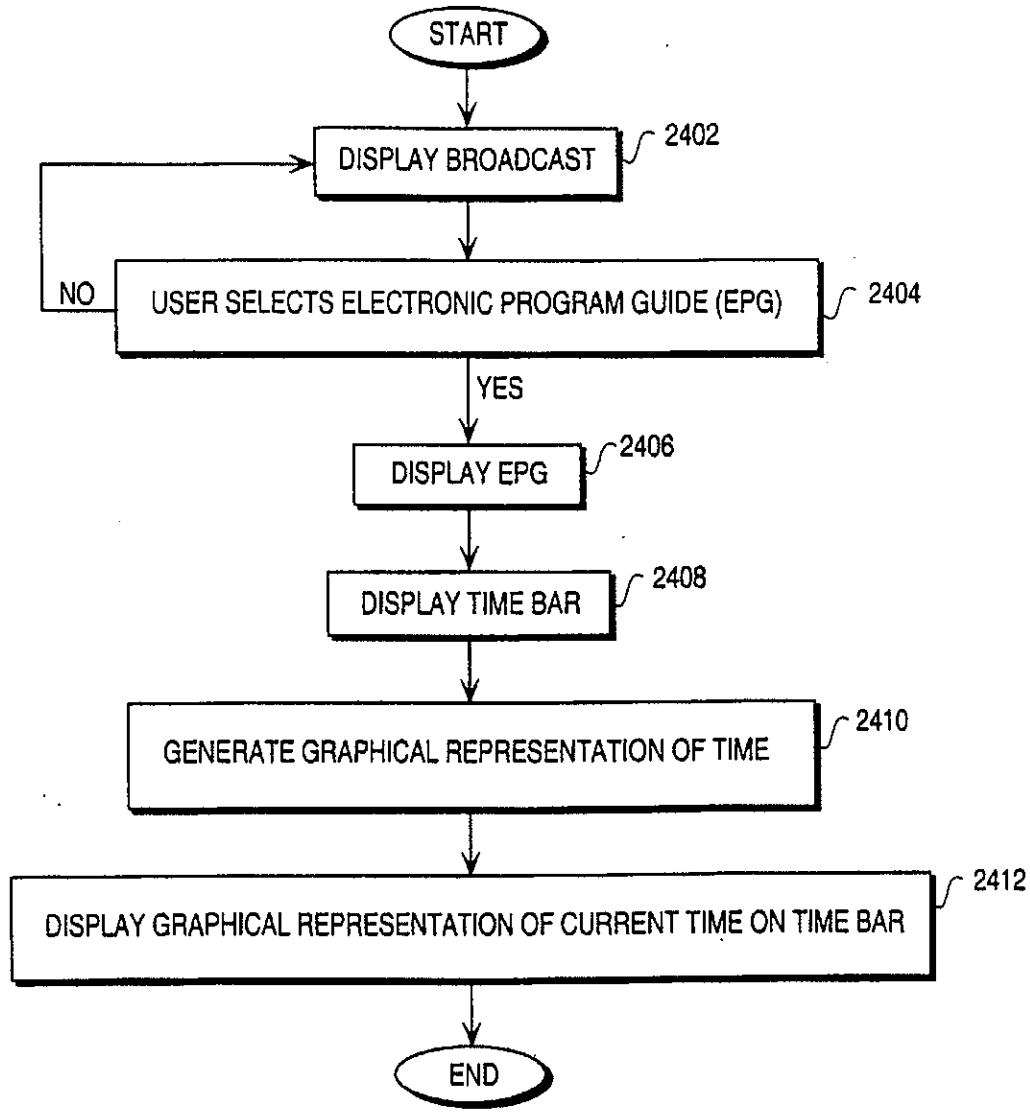

FIG. 24

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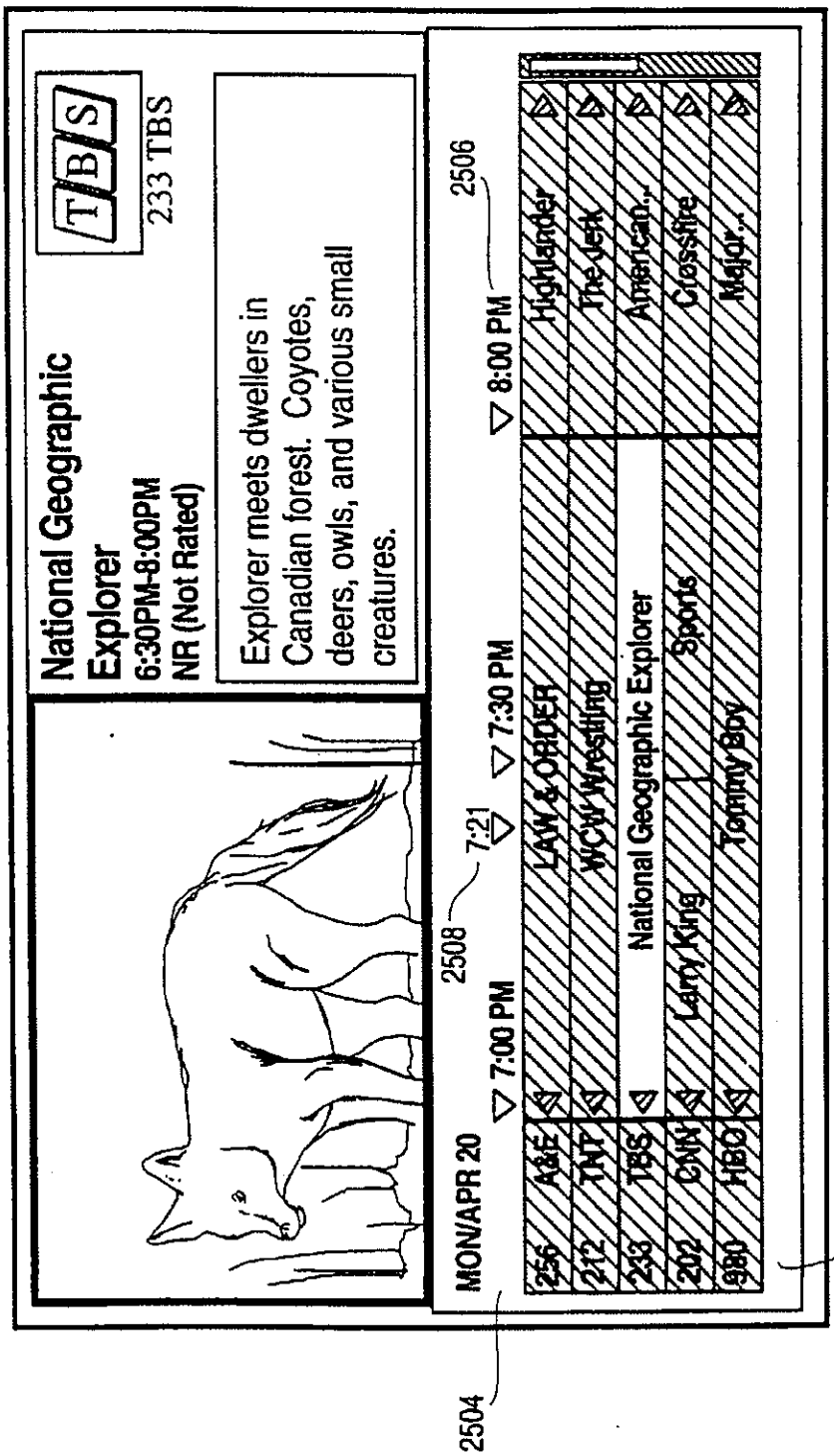

FIG. 25

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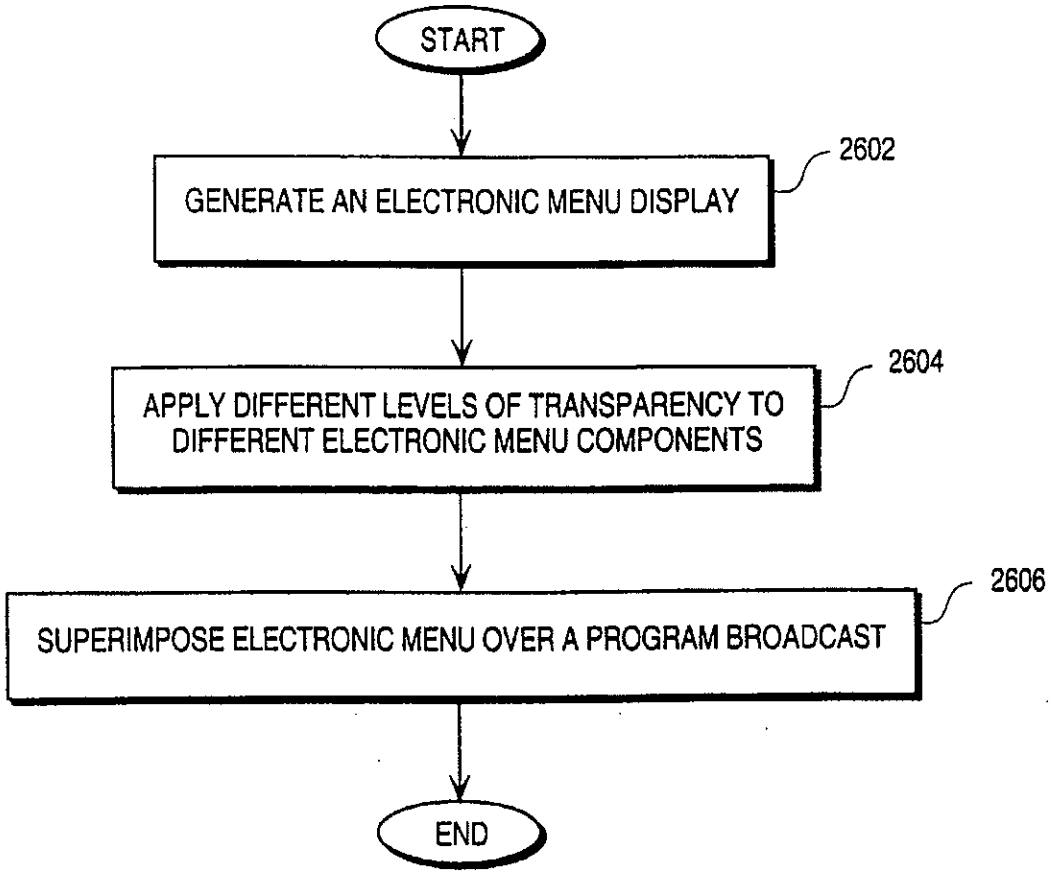

FIG. 26

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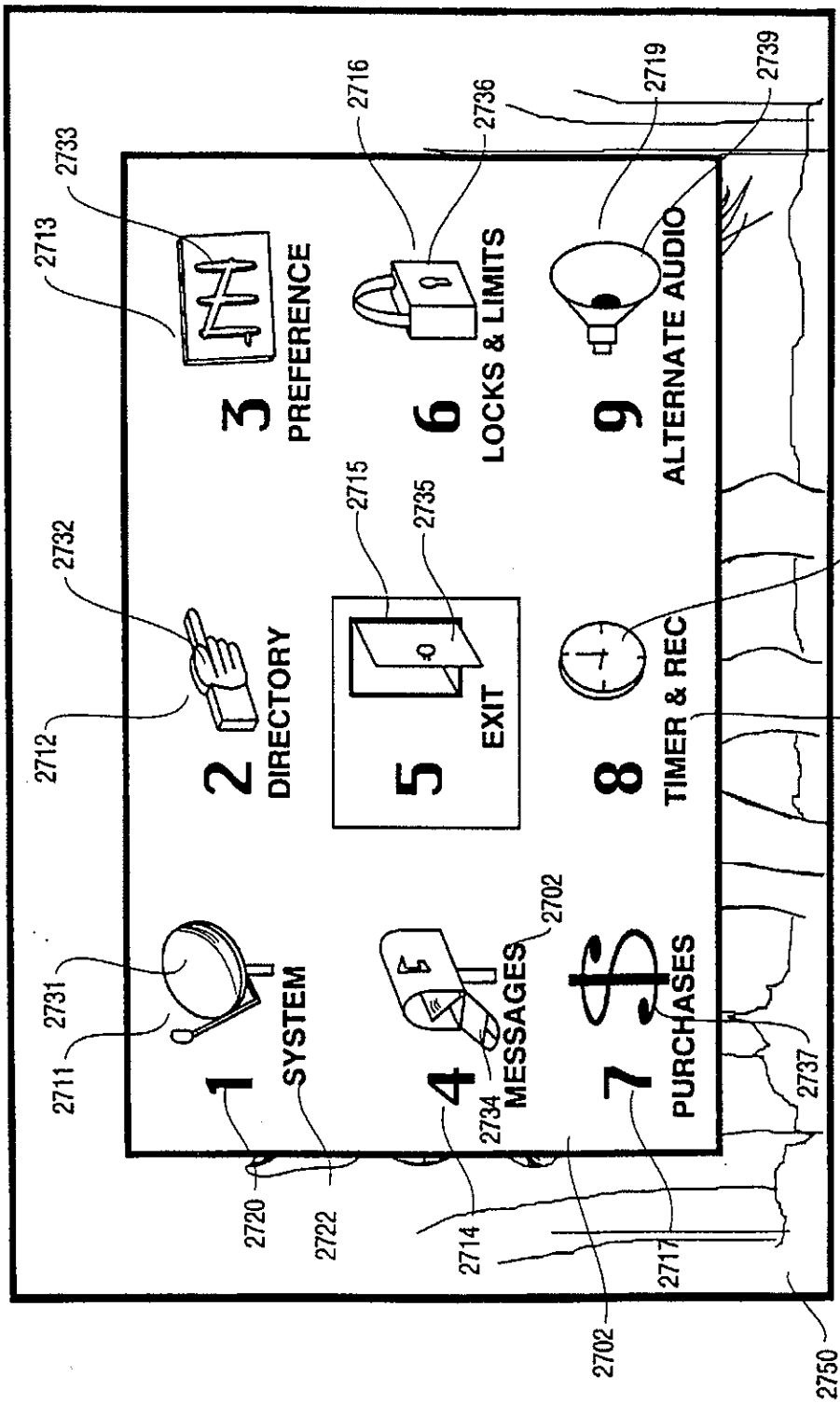

FIG. 27

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METHOD AND APPARATUS FOR DISPLAYING AN ELECTRONIC MENU HAVING COMPONENTS WITH DIFFERING LEVELS OF TRANSPARENCY

FIELD OF THE INVENTION

The present invention relates to the presentation of channel, program, and broadcast information for a multiple channel television broadcast system.

BACKGROUND OF THE INVENTION

Television broadcasting technology has improved tremendously since its inception. Today, television signals are broadcasted on the airwaves, through cables, and via satellite. The number of stations accessible today has increased to hundreds of stations. To select a program to view, many viewers simply "channel surf" until they find a channel that has a desirable program. Channel surfing refers to the process of using the channel "+" or "−" key to sequentially view each channel. Although some viewers find channel surfing among hundreds of stations enjoyable, most viewers prefer a more direct method for selecting a program to view.

Some prior art television channel select on guides provide a television channel selection guide which displays a listing of the channels typically in numeric order and the titles of the programs broadcasted or to be broadcasted on the channels. A simplified block diagram of such a guide is illustrated in FIG. 1. The viewer or user of the system may then select the channel by entering in the channel number or selecting a program. The system responds by removing the guide displayed and tuning to the station selected and displaying the broadcast signals of the station.

This system has a number of drawbacks. First, the guide provides only the title of the program. To get additional information, such as a written description of the program, the user must select an information button which responds by bringing up a second layer of the menu having the program description. Thus, as the number of stations increase, the efficiency of reviewing programs and program descriptions decreases.

Furthermore, many viewers prefer to preview an actual broadcast on a station before selecting that station for viewing. In the prior art systems, the user has to select each station to view, and subsequently go back to the channel guide in order to view program titles on other channels. While other prior art systems may provide a program listing having a transparent background superimposed over a program broadcast, it is still difficult to view the program broadcast through the program listing.

Moreover, in any television system a user can channel surf by skipping from channel to channel in sequence using the channel "up" or "down" buttons. However, when channel surfing in the prior art systems, the user is unable to take advantage of the channel listing and program description information. While some prior art television channel selection guides allow for channel surfing while the guide is displayed, these systems change the channel as the user moves a selection device or pointer to each new channel. Again this prevents taking full advantage of the broadcast system guide because, while the system guide provides program descriptions, a user might like to view a particular channel while surfing among the program descriptions of other channels.

Another shortcoming of prior art television channel selection guides is that, while providing the current time on the guide display, they do not provide a clear representation of the current time in relation to the channel program listings. Consequently, it is difficult for a user to ascertain the amount of time elapsed since a particular program began.

In the current generation of broadcasting technology, a viewer is provided with many options regarding programs that are available for broadcast. These options include, but are not limited to, on-demand selection of pay-per-view broadcasts, selection of a broadcast for automatic recording, and programming a broadcast system to tune to a preselected station at a designated time. As the number of options increases, so to does the need for a user-friendly system interface. The prior art channel selection guides do not provide a ready status indication as part of the channel selection guide. In addition, as the channel selection guides become more interactive and provide the viewer with more selections, the lack of status displays for system pointers and tuners can lead to a great deal of viewer frustration.

SUMMARY OF THE INVENTION

A method and apparatus for displaying an electronic menu having components with differing levels of transparency are provided. According to one aspect of the invention, a multiple channel broadcasting system generates an on-screen menu display for enabling a user to operate different functions of the system. The broadcasting system generates an electronic menu display that comprises a number of components, alphanumeric characters, and icons displayed on a background. The components, alphanumeric characters, and icons identify different functions of the system. The broadcast system applies different levels of transparency to the different components such that the number of opaque components is minimized. The transparency levels may be selected by the user. The background is highly transparent. The broadcast system then superimposes the electronic menu display over a program broadcast on a screen. As the opaque components are minimized, the obstruction of the broadcast by the electronic menu display is minimized.

These and other features, aspects, and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description and appended claims which follow.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features, and advantages of the present invention will be apparent to one skilled in the art from the following detailed description in which:

FIG. 1 is a simplified illustration of a prior art direct digital satellite system guide display.

FIG. 2 is a simple illustration of one embodiment of the present invention.

FIG. 3 is a block diagram representation of the elements utilized in the receiver of the television signals.

FIG. 4 is a representation of a remote control utilized to tune television stations in accordance with the teachings of the present invention.

FIG. 5 is a simplified block diagram of the circuitry utilized in a remote control device.

FIG. 6 illustrates the type of data utilized to present the electronic program guide in accordance with the teachings of the present invention.

FIG. 7 illustrates the pointers to the data utilized to generate the electronic program guide in accordance with the teachings of the present invention.

FIG. 8 illustrates the Master Guide presented to enable the viewer to view programming that is broadcast and is to be broadcast.

FIGS. 9A, 9B and 9C illustrate one embodiment of the present invention in which a broadcast audio and video is displayed behind the Master Guide.

FIG. 10 is an exemplary flowchart illustrative of translating a display to a small window in one embodiment of the present invention.

FIG. 11 illustrates a broadcast display in one embodiment of the present invention.

FIG. 12 illustrates superimposing successively smaller broadcast window outlines over a broadcast display in the translation of the broadcast window in one embodiment of the present invention.

FIG. 13 illustrates the display of an electronic program guide along with a program broadcast on a screen in one embodiment of the present invention.

FIG. 14 is an exemplary flowchart that illustrates integrating the translation of a display to a small window with other functions of a broadcast system in one embodiment of the present invention.

FIG. 15 illustrates the display of an electronic program guide in one embodiment of the present invention.

FIG. 16 is an exemplary flowchart illustrative of the process for optimizing the font size for an available display space in one embodiment of the present invention.

FIG. 17 is an exemplary flowchart illustrative of the process for integrating the process of optimization of the font size with other functions of a broadcast system in one embodiment of the present invention.

FIG. 18 is an exemplary flowchart illustrative of channel surfing in one embodiment of the present invention.

FIG. 19 is an exemplary flowchart illustrative of the process for providing tuner and pointer status display in one embodiment of the present invention.

FIG. 20 illustrates the display of an electronic program guide in one embodiment of the present invention.

FIG. 21 illustrates the display of an electronic subcategory guide with an electronic program guide in one embodiment of the present invention.

FIG. 22 is an exemplary flowchart that illustrates the process for providing an icon to indicate program status in one embodiment of the present invention.

FIG. 23 illustrates the display of an electronic program guide having program status icons in one embodiment of the present invention.

FIG. 24 is an exemplary flowchart that illustrates a process for providing a time bar with a current time marker in one embodiment of the present invention.

FIG. 25 illustrates the display of an electronic program guide having a graphical representation of the current time in relation to the times of channel programming in one embodiment of the present invention.

FIG. 26 is an exemplary flowchart that illustrates the process for providing an on-screen menu having differing transparency levels in one embodiment of the present invention.

FIG. 27 illustrates the display of an on screen menu having differing transparency levels in one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In the method and apparatus of the present invention the broadcast system described is a direct broadcast satellite system. However, it is readily apparent to one skilled in the art that other broadcast systems which have the capability of receiving and displaying a multiplicity of stations may utilize the method and apparatus of the present invention. Furthermore, in the following description, for purposes of explanation, numerous details are set forth, such as menus, flowcharts and system configurations, in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the present invention. In other instances, well known electrical structures and circuits are shown in block diagram form in order not to unnecessarily obscure the present invention.

FIG. 2 is a simplified diagram illustrating a Direct Satellite System (DSS). The system has an antenna 3, an integrated receiver/decoder 2 (IRD), a remote controller 5, and a monitor 4. Packets of data are transmitted by a transponder on the satellite. Each transponder transmits data in a time share manner at a predetermined frequency. A tuner 21 of a decoder is tuned in to the frequency of the transponder corresponding to a channel, which is designated by a viewer so that the packets of digital data are received by the decoder.

The antenna 3 receives an encoded data signal sent from a satellite. The received encoded signal is decoded by the IRD. The antenna 3 has a low noise block down converter 3*a* (LNB). The LNB 3*a* converts a frequency of a signal sent from the satellite to another frequency. The converted signal is supplied to the IRD 3. The monitor 4 receives a signal from the IRD 3.

FIG. 3 is a block diagram of the IRD 3. A radio frequency (RF) signal output from the LNB 3*a* of the antenna 3 is supplied to a tuner 21 of a front end 20. The output from the tuner 21 is supplied to a quadrature phase shift keying (QPSK) demodulation circuit 22 for demodulation. The output from the QPSK demodulation circuit 22 is supplied to an error correcting circuit 23 for error correction. The data is received in encrypted and encoded (i.e., compressed) form.

The transport IC 24 receives the data stream, consisting of packets of data, from the error correcting circuit 23 and directs portions of the data stream to the appropriate circuit for processing. The digital data stream sent from a satellite includes headers for classifying the different portions of the data in the digital data stream. The transport IC stores the headers in registers and uses the headers to direct the data. The data stream sent from the satellite, includes video data in the format specified by the Motion Pictures Expert Group standard (MPEG), MPEG audio data and electronic programming guide (EPG) data. Data that is identified by its header to be video data is transferred to MPEG video decoder 25. Data that is identified by its header to be audio data is transferred to MPEG audio decoder 26. Similarly, data having a header that identifies the data to be EPG data is transferred to a predetermined area in the data buffer 51 designated to store the EPG.

A conditional access module 33, includes a central processing unit (CPU), a read-only memory (ROM) and a random access memory (RAM). The conditional access module determines whether the user has the authorization to receive certain data, e.g., audio/video for a pay TV station, using the authorization information stored in its memory. Thus, if the conditional access module determines that the user is authorized access, a key to decrypt the incoming data is provided to the transport IC 24, which decrypts the data using the key provided. In one embodiment, a smart card is

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utilized. This card is inserted into the card reader interface **32** for interface to the transport IC **24**. It is readily apparent to one skilled in the art that the conditional access module is not limited to smart cards and may be configured in other kinds of circuitry.

The MPEG video decoder **25** decodes the video signal received from the transport IC. Dynamic random access memory (DRAM) **25***a*, connected to the MPEG video decoder **25**, is used for buffering and storage of video data during processing by the MPEG video decoder. The decoded digital video signal is supplied to a National Television System Committee (NTSC) encoder **27** and converted to a luminance signal (Y) and a chroma signal (C) which are respectively output through a buffer amplifier **28**Y or **28**C as an S video signal. A composite video signal is also output through a buffer amplifier **28**V.

The MPEG audio decoder **26** decodes the digital audio signal. DRAM **26***a*, connected to the MPEG audio decoder **26**, is used for buffering of data and information during processing by the MPEG audio decoder **26**. The decoded digital audio signal is converted into an analog audio signal by D/A converter **30**. The left audio signal is output through buffer amplifier **31**L and the right audio signal is output through buffer amplifier **31**R.

An RF modulator **41** mixes a composite signal output from the NTSC encoder **27** with an analog audio signal output from the D/A converter **30**. The RF modulator **41** converts the mixed signal into an RF signal and outputs the RF signal therefrom.

The CPU **29** is the central control mechanism and executes code stored in the ROM **37** to perform certain functions of the system. For example, the CPU processes certain data to control the generation of the program list in accordance with the teachings of the present invention. In addition, the CPU receives and processes the user input, received from the front panel buttons or switches **40** and the photodetector circuit **39** to provide the user functionality and access to the system described herein. In addition, the CPU accesses user settings/preferences for processing of information and configuration of the system. The user settings are stored in the non-volatile memory, such as electrically erasable programmable read-only memory (EEPROM) **38**. In addition, the CPU maintains a list of pointers, stored in static random access memory (SRAM) **36**, to the channel information and program information stored in the SRAM **51**. Thus, when a user wishes to display a form of the EPG on the screen, the CPU **29**, accessing pointers stored in the SRAM **36**, communicates to the transport IC **34** to retrieve the data from the data buffer (SRAM) **51** identified by the pointers. The CPU then formulates the format and other digital data which forms the guide or list on the screen and forwards the data representative of the guide/list to the transport IC **34** which forwards the data to the DRAM **25***a* of the MPEG video decoder **25** for subsequent output to the screen.

FIG. **4** shows an example of a remote controller utilized by a user to transmit commands and make program selections in accordance with the teachings of the present invention. FIG. **5** is simplified a block diagram of the remote controller. The remote controller **400** has an infrared originating device **405**, a set of operation buttons **410**, a CPU **415**, a ROM **420** and a RAM **425**. The CPU **415** receives a signal sent from an operation button **410** through an input port **430**. The signal is processed according to a program stored in the ROM **420**. The RAM **425** is used as a working space so as to produce a transmitting code. The transmitting code is sent to the infrared originating device **405** through an output port and converted into an infrared signal. The infrared signal is transmitted to the IRD. The operation buttons **410** include a direction key for designating a pointer direction such as north, south, east and west, an "EPG" key, a "FAVORITE" key, a "SELECT KEY", a "MENU" key, an "EXIT" key, a ten-key numeric keypad and an "ENTER" key. The set of operation buttons **410** enable the user to select programs through the electronic programming guide in accordance with the teachings of the present invention.

FIG. **6** is a block diagram illustration of the data stored in a portion of the data buffer RAM **51**. As noted above, the RAM **51** stores EPG data including guide data, channel data, and program data. General information is included in the guide data, for example, the current date and time. The transponder list identifies the number of the transponder transmitting a segment. The channel list identifies the channel number of the first channel of a portion of data. The channel data includes data relating to channels, such as the channel number, channel name (i.e., the call sign of a broadcast station), logo ID (i.e., an identification of the channel logo), data ID, which is an identification of a channel number of MPEG video data or MPEG audio data, number of programs, which identifies the number of programs to be transmitted on a channel during a predetermined time frame, and first program offset which identifies the offset from the header to the first channel data in a segment.

The program data includes the program title, start time of the program, time length of the program, program category such as movies, news, sports, etc., program subcategory such as drama, horror, children's movies or baseball, basketball, football for the sports category, the movie rating and program description that provides a detailed description of the program.

FIG. **7** illustrates how pointers to the EPG data are sorted for display on a guide on the user's television screen. As noted above, EPG data includes guide data, channel data and program data which are stored in the Data Buffer (RAM) of the IRD (as shown in FIG. **3**). When a viewer selects a channel, the CPU of the system determines the packet containing the channel information and extracts the transponder number from the channel information. The system front end starts tuning in the frequency of the designated transponder so as to receive the data transmitting from that transponder. If a viewer does not select any channel, the last channel is designated.

As noted above, the CPU generates a table of pointers **736** to the EPG stored in the memory. The table **736** is used for changing the order of channels or programs according to the information to be presented in the guide to the user. The table **736** includes an entry for the address pointer to the corresponding channel data and an entry to the corresponding program data.

A table for generating display information is stored in the ROM **37**. Certain data from the table is read out from the ROM **37** and stored in DRAM **25***a*. Preferably the data is stored in compressed form. Therefore, when a character is displayed on a screen, the compressed character array is decoded so as to generate the character to be displayed. The encoder references a dictionary which includes a set of words and frequently used portions of words and numbers corresponding to each word or portion of a word. The encoder encodes each word to each number by using the dictionary. The decoder references the same dictionary as the encoder to perform the decode function. Once decoded, each character of the decoded word includes a character

code corresponding to an American Standard Code for Information Interchange (ASCII) code. Nonvolatile memory (e.g., EEPROM **38**) has two tables. The first table contains character bitmaps in the different fonts available for each character. The second table identifies the address in the first table at which to extract the character bitmap. The address is determined according to the character code. The bit map image of the character is transmitted to DRAM **25***a* and subsequently accessed to display the character on the screen.

In one embodiment of the present invention, the channel data is received from a predetermined transponder and the channel number and channel name are stored in DRAM **25***a*. Additional channel information such as the channel logo is stored in the ROM **36**. The ROM **36** preferably includes a table of Logo IDs and the address of Logo Data stored in ROM **36**. Therefore, once a Logo ID is determined, the address of the Logo Data is determined, retrieved and stored in DRAM **25***a*.

The channel data provides the beginning address of the program data for a particular program. The actual location on the screen at which the program information is displayed is dependent upon the format of the guide. For example, in a time-based system, the location where the program title is displayed is determined by the start time and time length stored in the program data.

Using this information downloaded from the satellite transmission, programming and channel selection information is provided to the viewer. In the system and method of one embodiment of the present invention, this information is provided to the user in an innovative manner in order to enable the viewer to easily determine and select stations or programs to be viewed. For example, FIG. **8** illustrates a Master Guide that provides such information as the channel call sign **800**, channel number **815** in the system, the channel logo of the selected station **820**, a highlight **825** indicating the location of the system pointer operable by the arrow direction buttons, a program description **830** for the program the system pointer is located at, as well as program time information **835**.

This guide is superimposed on the broadcast of channel **840** at which the system pointer is located. Thus, the user not only is provided the television system data showing the television channels, times of programming broadcasts and descriptions of programs, but is also provided the audio and video of one channel, all on the same menu level of the guide. By movement of the pointer **845** (in the present example, by manipulation of the information highlighted), the channel tuned to will change automatically, enabling the user to stay in the menu while still previewing in part the actual channel highlighted on the guide. This process is illustrated by FIGS. **9**A, **9**B, and **9**C. The discussion will now turn to general process flows for an embodiment of the present invention.

It is readily apparent to one skilled in the art that additional functions can be added to the process and functions modified or removed and still be within the spirit and scope of the invention. The system provides an innovative and user friendly access to a wealth of information regarding programming available through the broadcasting system. In the present invention a number of functions are selectable through the remote control device. It is apparent that these functions may be selectable through other devices such as a joystick or other means such as an on screen menu.

FIG. **10** is an exemplary flowchart illustrative of translating a display to a small window in one embodiment of the present invention. The resizing process provides innovative feedback to the user while providing the broadcast system time to perform the computations necessary to resize the window. In the present embodiment, the broadcast display is translated to a small window when the user selects to display the electronic program guide. Thus both the broadcast and the electronic program guide are displayed without overlap. It is readily apparent that the window resizing process can be used to resize windows for a variety of purposes.

Referring to FIG. **10**, operation begins at Block **1000**, at which a broadcasting system is tuned to a channel to provide a display of a broadcast of a program. The broadcast window corresponds to the entire display. FIG. **11** illustrates a broadcast display **1102** in one embodiment of the present invention. It is readily apparent that the window size need not initially correspond to the entire display but can be some portion of the display. Operation continues at Block **1002**, at which a series of successively smaller broadcast window outlines are superimposed over the program display when it is desirable to translate to a smaller window. FIG. **12** illustrates superimposing these successfully smaller broadcast window outlines **1202**–**1210** over a broadcast display **1201** in the translation of a broadcast window in one embodiment of the present invention. With reference to FIG. **12**, outline **1202** is displayed first, followed by outlines **1204**, **1206**, **1208**, and **1210**, respectively. Preferably, outline **1202** is shorter in length and narrower in width than the screen perimeter **1220**, although it is contemplated that the outlines can progress in one dimension. Each of outlines **1204**, **1206**, **1208**, and **1210** is shorter in length and narrower in width than the preceding outline, respectively.

Referring again to FIG. **10**, operation continues at Block **1004**, at which the program display is translated to a smaller broadcast window. Preferably the size of the broadcast window is not changed until the size of the smallest superimposed broadcast window outline equals a predetermined smallest broadcast window size. In an alternate embodiment, the size of the broadcast window changes as the size of the outline changes.

Operation continues at Block **1006**, at which programming information in the form of an electronic program guide is displayed on the screen with the broadcast on the screen such that no portion of the broadcast is covered by the electronic program guide. In an alternate embodiment, programming information is displayed performed prior to the translation of the program broadcast.

FIG. **13** illustrates one embodiment of a display of an electronic program guide **1301** with the program broadcast **1310** on a screen **1320**. The electronic program guide **1301** includes the broadcast channel number **1330**, the broadcast network identification **1332**, the program title **1334**, the start and end times for a program **1336**, the current day **1338**, the current date **1340**, and the current time **1342**. It is readily apparent that other embodiments of displays of electronic program guides presenting different information may be utilized.

Referring to FIG. **13**, a user is able to readily view not only the broadcast audio and video, but also the electronic program guide of programming and the program description. A display information packet **1302** containing a description of the program broadcast may be displayed with the electronic program guide **1310**. The display information packet **1302** also contains the program title **1350**, the broadcast network identification **1352**, the broadcast channel number **1354**, the start and end times of the program **1356**, and the program rating **1358**. Alternatively, the user may selectively replace the display of the display information

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packet **1302** with the display of an electronic category guide. The electronic category guide contains a listing of programming categories.

After viewing the programming selections on the electronic program guide, a viewer may deselect the electronic program guide display. The electronic program guide display is also deselected upon selection of a channel by the user. Upon deselection of the electronic program guide, the broadcast system translates the broadcast of a program displayed in the small window by superimposing a series of successively larger broadcast window outlines over the display. In the present embodiment, the first larger broadcast window is longer in length and wider in width than the small window in which the program is displayed. Each successive outline is longer in length and wider in width than the preceding outline. Following the translation, the video broadcast is redisplayed in an area defined by each successively larger broadcast window outline.

FIG. **14** is an exemplary flowchart that illustrates one embodiment of the process for integrating the translation of a display to a small window with other functions of a broadcast system. Operation begins at Block **1402**, at which a television screen or display is currently showing a broadcast of a selected station. Operation continues at Block **1404**, at which a user may select the electronic program guide for display. The system monitors the states of the buttons on a user's remote control device to determine when the user has depressed a certain button. Implementation of monitoring, e.g., polling, interrupt driven events, are well known in the art and will not be discussed further herein. If the user does not select the electronic program guide for display operation continues at Block **1402**, at which the system continues to display the broadcast and monitors selection by the user of the electronic program guide function. If the user does select the electronic program guide for display at Block **1404**, then operation continues at Block **1406**, at which a series of successfully smaller broadcast window outlines are displayed.

Operation continues at Block **1408**, at which the display of a broadcast is translated to a smaller broadcast window on the display. Operation continues at Block **1410**, at which an electronic program guide is displayed in an area adjacent to the smaller broadcast window. An exemplary electronic program guide was previously discussed with reference to FIG. **13**. Operation continues at Block **1412**, at which a display information packet is displayed along with the electronic program guide in an area adjacent to the broadcast window on the electronic program guide. The display information packet contains a description of the program that is currently selected. Operation continues at Block **1414**, at which a user may select an electronic category guide for display using the buttons on the remote control. If the user selects the display of an electronic category guide, operation continues at Block **1416**, at which the display of an electronic category guide replaces the display of the display information packet. The electronic category guide includes a number of programming categories. The broadcast system then identifies programs on channels that correspond to each category contained in the electronic category guide. The programs that correspond to the particular categories of the electronic category guide are then highlighted on the electronic program guide.

If the user does not select the electronic category guide for display, or following the display of the electronic category guide when the user selects the electronic category guide for display, operation continues at Block **1418**, at which the user may deselect the display of the electronic program guide using the buttons on the remote control. If the user does not deselect the electronic program guide at Block **1418**, operation continues at Block **1410**, at which the broadcast system continues to display the electronic program guide. If the user does deselect the electronic program guide at Block **1418**, operation continues at Block **1420**, at which a series of successfully larger broadcast window outlines are displayed. Operation continues at Block **1422**, at which the electronic program guide is removed from the display. If the electronic category guide was not selected by the user, then the display information packet is also removed from the display at Block **1422**. If the electronic category guide was selected by the user, then the electronic category guide is also removed from the display at Block **1422**. Operation continues at Block **1424**, at which the display of the broadcast is translated to a larger window on the display screen.

As noted earlier and referring again to FIG. **13**, the user may select a display information packet for display along with the electronic program guide. In one embodiment, the display information packet contains a description of the program selected for display. Preferably, the system automatically resizes the text of the display information packet such that all the text appears in the window. FIG. **15** illustrates a display of an electronic program guide in one embodiment of the present invention that is displayed with a display information packet **1502** that contains a greater number of characters than the display information packet **1302** of FIG. **13**. As the area allocated for the display information packet in one embodiment of the broadcasting system is of a constant fixed size, the broadcasting system is configured to adjust the font size of the characters based on the number of characters present for display. Optimization of the font size causes a maximum number of characters to be displayed for a given display area.

FIG. **16** is an exemplary flowchart illustrative of the process for optimizing the font size for an available display space in one embodiment of the present invention. Operation begins at Block **1602**, at which the broadcast system determines a number of characters to be displayed. Operation continues at Block **1604**, at which the broadcast system determines the number of display pixels available for character display. Operation continues at Block **1606**, at which the broadcast system adjusts the character font size in order to display all characters in the available number of display pixels. Operation continues at Block **1608**, at which the broadcasting system displays the characters in the display information packet.

FIG. **17** is an exemplary flowchart illustrative of the process for integrating the process of optimization of the font size in the display information packet with other functions of a broadcast system in one embodiment of the present invention. Operation begins at Block **1702**, at which a television screen or display is currently showing a broadcast of a selected station. Operation continues at Block **1704**, at which a user may select a display of an electronic program guide. If the user does not select the electronic program guide for display, operation continues at Block **1702**, at which the system continues to display the broadcast. If the user does select the display of an electronic program guide operation continues at Block **1706**, at which the electronic program guide is displayed. Operation continues at Block **1708**, at which a user selects a display information packet for display along with the electronic program guide.

Upon selection of the display information packet for display, operation continues at Block **1710**, at which the broadcast system determines the number of pixels available for the display information packet. Operation continues at

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Block **1712**, at which the broadcast system determines the number of characters in the display information packet that are to be displayed. In one embodiment, the maximum number of characters is 256. Operation continues at Block **1714**, at which the broadcasting system determines if the number of characters is less than 180. One embodiment of the present invention uses three font sizes for the displaying characters in the display information packet. If the broadcast system determines at Block **1714** that the number of characters is less than 180, then the broadcast system selects the largest of the three font sizes. Following selection of the largest font size, operation continues at Block **1722**, at which the broadcast system displays the display information packet using the largest font.

If the broadcast system determines at Block **1714** that the number of characters is not less than 180, then operation continues at Block **1716**, at which the broadcasting system determines if the number of characters is greater than 180 and less then 220 characters. If the number of characters is greater than 180 and less than 220 then the broadcast system selects the medium font size. Following selection of the medium font size, operation continues at Block **1722**, at which the broadcast system displays the display information packet using the medium sized font.

If the broadcast system determines at Block **1714** that the number of characters is not more than 180 and less than 220, then operation continues at Block **1718**, at which the broadcast system determines that the number of characters is more than 220. Operation continues at Block **1720**, at which the broadcast system selects the smallest of the three font sizes. Operation continues at Block **1722**, at which the broadcast system displays the display information packet using the smallest font size.

Because the number of television broadcasting stations accessible today includes hundreds of stations, many viewers channel surf until they find a channel that has a desirable program. Channel surfing refers to the process of using the channel plus or minus key to sequentially view each channel. While some viewers find channel surfing among hundreds of stations enjoyable, some viewers prefer a more direct method of program selection. For this reason, an embodiment of the system of the present invention uses two modes, a non-channel surfing mode and a channel surfing mode, from which a user may select channels to view.

The non-channel surfing mode is described with reference to FIGS. **9A**, **9B**, and **9C**. When the user selects the non-channel surfing mode, the broadcast system is first tuned to a channel **233** to provide a broadcast of a program on the screen or display **910**. The user then selects a display of an electronic program guide **912** for identifying the channels available on the broadcast system and the programming available on the channels. A display information packet **916** is displayed along with the electronic program guide **912**, and the display information packet **916** contains a description of the program to which the broadcast system is currently tuned. Furthermore, a system pointer **918** is displayed on the electronic program guide **912**. The system pointer **918** is used to select a program for viewing by the user and, as such, may be manipulated by the user within the area of the electronic program guide **912**. In the non-channel surfing mode the broadcast system is tuned to the channel that is pointed to by the system pointer **918**. Furthermore, the display information packet **916** displays a program description for the program to which the broadcasting system is tuned. Therefore, when the user manipulates the system pointer to a different channel **229** and **240** in the non-channel surfing mode, the broadcast system tunes to that channel and displays the program **975** and **930** currently being broadcast on that channel, respectively.

In contrast to the non-channel surfing mode, is the channel surfing mode of one embodiment of the present invention. FIG. **18** is an exemplary flowchart illustrative of the process of channel surfing in one embodiment of the present invention. At Block **1802**, the broadcast system is tuned to a first channel and a display is generated consisting of a broadcast window, an electronic program guide, a display information packet, and a system pointer. A first program broadcast is displayed in the broadcast window. Operation continues at Block **1804**, at which a display information packet is displayed for the first program broadcast. This display information packet contains a description of the first program broadcast. At Block **1806**, the user moves the system pointer to an area of the electronic program guide associated with a second program broadcast. Operation continues at Block **1808**, at which the broadcast system replaces the display information packet of the first program with a display information packet of a second program broadcast. The broadcast system remains tuned to the first program broadcast and continues to display the first program broadcast.

In the channel surfing mode the user may manipulate the system pointer to a program or channel in the electronic program guide that is different from the program or channel currently being broadcast. For this reason, it is preferred that the broadcast system provides in the electronic program guide an indication to the user as to the status of the broadcast system tuner and the system pointer. However, the status indication is not required to operate the channel surfing mode in accordance with the teachings of the present invention. FIG. **19** is an exemplary flowchart illustrative of the process for providing tuner and pointer status display in one embodiment of the present invention. An electronic program guide is generated at Block **1902**. At Block **1904**, a system pointer is supplied for the electronic program guide. Operation continues at Block **1906**, at which a status indication is provided of the system tuner and the system pointer.

Each program displayed in the electronic program guide is displayed in a program block or area that is associated with a particular channel and a particular time slot. The status indication is provided by controlling the appearance of the program block in accordance with the location of the system pointer and the channel to which the system is tuned. In particular, when the broadcast system is tuned to a program, and therefore the broadcast window displays the programming of the channel the system is tuned to, the corresponding program block is displayed on the electronic program guide as appearing to be depressed into the screen. The program blocks of the remaining programs not broadcasted but shown in the electronic program guide appear to be protruding from the screen. Therefore, when the broadcasting system is not tuned to a program the corresponding program block is displayed on the electronic program guide as appearing to be protruding from the screen. The status indication of the system pointer causes a different effect. In particular, when the system pointer is pointing to a program the corresponding program block is displayed as highlighted on the electronic program guide. When the system pointer is not pointing to a program the corresponding program block is displayed as not highlighted on the electronic program guide.

There are four primary combinations of the status indications as used by an embodiment of the broadcast system of the present invention. First, the display of a program block appears depressed into the screen and highlighted to

indicate that the broadcast system is tuned to the corresponding program and the system pointer is pointing to the corresponding program. Second, the display of a program block appears depressed into the screen and unhighlighted to indicate that the broadcast system is tuned to the corresponding program while the system pointer is pointing to a different program. Third, the display of a program block appears protruding from the screen and highlighted to indicate that the system pointer is pointing to the corresponding program while the broadcast system is tuned to a different program. Fourth, the display of a program block appears protruding from the screen and unhighlighted to indicate that the broadcast system is not tuned to the corresponding program and the system pointer is not pointing to the corresponding program.

FIG. **13** illustrates a tuner and pointer status display in one embodiment of the present invention. The broadcast system of FIG. **13** is tuned to the National Geographic Explorer program on the TBS network as indicated by the corresponding program block **1380** appearing to be depressed into the screen. The system pointer is also pointing to the National Geographic Explorer program as indicated by the highlighting of program block **1380**.

FIG. **20** illustrates the situation in which a broadcast system is tuned to one channel and the system pointer is pointing somewhere other than to the channel which is tuned. In particular, the broadcast system of FIG. **20** is tuned to the National Geographic Explorer program on the TBS network as indicated by the corresponding program block **2002** appearing to be depressed into the screen. An electronic category guide is selected for display instead of a display information packet. The system pointer is pointing to the "ALL" category box **2004** in the electronic category guide as indicated by the highlighting of the category block **2004**.

As shown in FIG. **20**, instead of selecting a display information packet for display at Block **1806** of FIG. **18**, the user may select an electronic category guide **2006** for display with the electronic program guide **2001**. The electronic category guide **2006** includes a number of programming categories **2010**. The broadcast system then identifies programs on channels that correspond to each category **2010** contained in the electronic category guide **2006**. The programs that correspond to the particular categories of the electronic category guide **2006** are then indicated or highlighted on the electronic program guide **2001**. The system pointer may be manipulated by the user to an area of the electronic category guide **2006**, and system pointer status is indicated. When the system pointer is pointing to a category block the category block is displayed as highlighted on the electronic category guide **2006**. The system pointer is pointing to the "ALL" category block **2004** in the electronic category guide **2006** as indicated by the highlighting of category block **2004**.

If the user, typically using the broadcast system remote control, selects one of the categories from the electronic category guide, then the display of the electronic category guide is replaced with a display of an electronic subcategory guide. FIG. **21** illustrates the display of an electronic subcategory guide **2102** with an electronic program guide **2104** in one embodiment of the present invention. The selected category **2106** is displayed along with the electronic subcategory guide **2102** and the electronic program guide **2104**. The electronic subcategory guide **2102** includes a number of subcategories **2108**. The broadcast system identifies programs on channels that correspond to each subcategory contained in the electronic subcategory guide **2102**. The programs that correspond to the particular categories of the electronic subcategory guide **2102** are indicated or highlighted on the electronic program guide. The status of the system pointer is shown and changed as the pointer is moved about the display. For example, the system pointer may be manipulated by the user to an area of the electronic subcategory guide **2102**. When the system pointer is pointing to a subcategory block the subcategory block is displayed as highlighted on the electronic category guide. In FIG. **21**, he system pointer is pointing to the "ALL" subcategory block **2108** in the electronic subcategory guide **2102** as indicated by the highlighting of subcategory block **2108**.

The multiple channel broadcasting system of one embodiment of the present invention provides a user with several options regarding the programs available for broadcast. The multiple channel broadcasting system allows the user to select pay-per-view broadcasts for purchase. In addition, the broadcast system allows the user to select corresponding programs for recording. Furthermore, the multiple channel broadcasting system allows the user to set a broadcasting system timer to automatically tune the broadcasting system to a program at a particular time. Moreover, the multiple channel broadcasting system allows the user to designate certain programs as favorite programs. Consequently, the multiple channel broadcasting system of one embodiment of the present invention displays icons that provide the user with the status of the programs while viewing the electronic program guide.

FIG. **22** is an exemplary flowchart that illustrates the process for providing an icon to indicate program status in one embodiment of the present invention. Operation begins at Block **2202**, at which the broadcasting system is tuned to display a program broadcast. Operation continues at Block **2204**, at which an electronic program guide is generated. Electronic menus may be displayed along with the electronic program guide. The electronic menus control pay-per-view purchases, selections of programs for recording, setting of the broadcasting system timer, and selection of favorite programs. At Block **2206**, graphic images are generated that indicate program status. Operation continues at Block **2208**, at which the graphic images are displayed within the electronic program guide. The icons or graphic images may serve as electronic links between the electronic program guide and a corresponding menu of the electronic menus and a display information packet.

FIG. **23** illustrates the display of an electronic program guide having program status icons in one embodiment of the present invention. The icon **2302** displayed in program block **2304** to indicate that a pay-per-view broadcast is selected resembles a dollar sign. The icon **2306** displayed in program block **2308** to indicate that a broadcast is selected for recording resembles a videocassette tape. The icon **2310** displayed in program block **2312** to indicate that the broadcast system timer is set to tune the broadcast system to a program at the time of the corresponding program resembles a clock. An icon may be displayed in a program block to indicate that a program is a favorite program. Icon **2314** in program block **2316** is one possible representation of a favorite program icon.

The multiple channel broadcasting system of one embodiment of the present invention provides a display of the time wherein a user can view the current time in relation to the times of programming and the program blocks. FIG. **24** is an exemplary flowchart that illustrates a process for providing a time bar with the current time marker in one embodiment of the present invention. Operation begins at Block **2402**, at which a television screen or display is currently showing a

broadcast of a selected station. Operation continues at Block **2404**, at which a user may select a display of an electronic program guide. If the user does not select display of an electronic program guide operation continues at Block **2402**, at which the broadcasting system continues to display the broadcast of the currently selected station. If the user selects the display of an electronic program guide, operation continues at Block **2406**, at which the electronic program guide is displayed by the broadcast system.

Following display of the electronic program guide, operation continues at Block **2408**, at which a time bar is displayed that identifies times of programming on the channels in the broadcasting system. Operation continues at Block **2410**, at which a graphical representation of the current time is generated. Operation continues at Block **2412**, at which the graphical representation of the current time is displayed in proximity to the time bar so as to indicate the current time in relation to the times of programming on the channels of the broadcast system. In one embodiment of the present invention the graphical representation of time is displayed as an inverted triangle on the time bar. The graphical representation of time may include a digital display of the current time. The graphical representation of time may also include an icon with the display of the current time.

FIG. **25** illustrates the display of an electronic program guide and a graphical representation of the current time in relation to the times of channel programming in one embodiment of the present invention. When the user selects the display of an electronic program guide, the electronic program guide **2502** is displayed by the broadcast system. With the electronic program guide, a time bar **2504** is displayed that identifies times of programming **2506** on the channels in the broadcasting system. An embodiment of the present invention generates a graphical representation of the current time **2508**. This graphical representation of the current time **2508** is displayed in proximity to the time bar **2504** so as to indicate the current time in relation to the times of programming on the channels of the broadcast system. This graphical representation of the current time **2508** is displayed as an inverted triangle on the time bar and includes a digital display of the current time.

In addition to the electronic program guide discussed herein, an embodiment of the multiple broadcasting system of the present invention provides an on screen menu display that enables the user to operate different functions of the system. FIG. **26** is an exemplary flowchart that illustrates the process for providing an on screen menu having differing transparency levels in one embodiment of the present invention.

In FIG. **26**, operation begins at Block **2602**, at which an electronic menu display is generated. The menu display comprises multiple components, multiple alphanumeric characters, and multiple icons that identify different functions of the broadcast system. Operation continues at Block **2604**, at which different levels of transparency are applied to the different electronic menu components. The different levels of transparency are applied to the components so that the number of opaque components is minimized and the background is highly transparent. Operation continues at Block **2606**, at which the electronic menu is superimposed over the display of a program broadcast. While the opaque components are minimized, the obstruction of the video of the broadcast by the electronic menu display is minimized. Preferably, the different transparency levels may be selected by the user.

When the user selects an electronic menu for display, then alphanumeric characters and icons are generated that identify different broadcast system functions. The user may select the transparency levels to be applied to the characters and icons of the electronic menu display. If the user does not select the transparency levels to be applied to the characters and icons of the electronic menu, then the multiple channel broadcasting system applies the least transparent level of transparency to the electronic menu icons. Furthermore, the multiple channel broadcasting system applies the least transparent level of transparency to the verbal description of the broadcasting system functions. Moreover, the multiple channel broadcasting system applies the most transparent level of transparency to the numerals of the electronic menu display.

FIG. **27** illustrates the display of an on screen menu having differing transparency levels in one embodiment of the present invention. The electronic menu display **2702** comprises multiple components **2711–2719**, multiple alphanumeric characters **2720–2722**, and multiple icons **2731–2739** that identify different functions of the broadcast system. Different levels of transparency are applied to the different electronic menu components. The different levels of transparency are applied to the components so that the number of opaque components is minimized and the background is highly transparent. Following generation of the electronic menu **2702**, the electronic menu **2702** is superimposed over a program broadcast **2750**.

The invention has been described in conjunction with the preferred embodiment. Although the present invention has been described with reference to specific exemplary embodiments, it will be evident that various modifications and changes may be made to these embodiments without departing from the broader spirit and scope of the invention as set forth in the claims. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

What is claimed is:

1. In a multiple channel broadcasting system in which programs are broadcasted for display on a screen, a method for generating an on-screen menu display for enabling a user to operate different functions of the system, comprising the steps of:

generating an electronic menu display, said menu display comprising a plurality of components, comprising a plurality of alphanumeric characters and icons identifying different functions displayed on a background;

applying different levels of transparency to different components such that a number of opaque components is minimized, and the background is highly transparent;

superimposing said electronic menu display over a program broadcast on said screen, said opaque components minimized thereby minimizing obstruction of the video of the broadcast by the electronic menu display.

2. The method as set forth in claim **1**, wherein said transparency levels are selected by said user.

3. The method as set forth in claim **1**, wherein each function is identified by a plurality of components, at least one of the plurality of identifying components having a high level of transparency.

4. The method as set forth in claim **1**, wherein each of said plurality of icons has the least transparent level of transparency.

5. The method as set forth in claim **4**, wherein a numeral is displayed along with each of said plurality of icons, said numeral having the most transparent level of transparency.

6. The method as set forth in claim **5**, wherein a verbal description is displayed along with each of said plurality of icons, said verbal description having the least transparent level of transparency.

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7. The method as set forth in claim 6, wherein the least transparent level of transparency is selected for the plurality of icons and the corresponding verbal descriptions.

8. A broadcast system comprising:

a display device;

a processor coupled to said display device, said processor,

configured to control the system to generate an electronic menu display, said menu display comprising a plurality of components, comprising a plurality of alphanumeric characters and icons identifying different functions displayed on a background;

configured to control the system to apply different levels of transparency to different components such that a number of opaque components is minimized, and the background is highly transparent;

configured to control the system to superimpose said electronic menu display over a program broadcast on said screen, said opaque components minimized thereby minimizing obstruction of the video of the broadcast by the electronic menu display.

9. The broadcast system as set forth in claim 8, wherein each function is identified by a plurality of components, at least one of the plurality of identifying components having a high level of transparency.

10. The broadcast system as set forth in claim 8, wherein each of said plurality of icons has the least transparent level of transparency.

11. The broadcast system as set forth in claim 10, wherein a verbal description is displayed along with each of said plurality of icons, said verbal description having the least transparent level of transparency.

12. A system for providing an on-screen menu display for enabling a user to select different functions of a multiple channel broadcasting system while viewing a broadcast, comprising:

a broadcast displayed on a viewing display;

an electronic menu comprising a plurality of components identifying said different functions of the system, said plurality of components including a plurality of alphanumeric characters and icons displayed on a background, each of said components having a level of transparency such that a number of components having a low level of transparency is minimized, said electronic menu superimposed over the displayed broadcast.

13. The system as set forth in claim 12, wherein each function is identified by a plurality of components, at least one of the plurality of identifying components having a high level of transparency.

14. The system as set forth in claim 12, wherein each of said plurality of icons has the least transparent level of transparency.

15. The system as set forth in claim 14, wherein a verbal description is displayed along with each of said plurality of icons, said verbal description having the least transparent level of transparency.

16. A computer readable medium containing executable instructions which, when executed in a processing system, causes the system to perform the steps for generating an on-screen menu display of a multiple channel broadcasting system comprising:

generating an electronic menu display, said menu display comprising a plurality of components, comprising a plurality of alphanumeric characters and icons identifying different functions displayed on a background;

applying different levels of transparency to different components such that a number of opaque components is minimized, and the background is highly transparent;

superimposing said electronic menu display over a program broadcast on said screen, said opaque components minimized thereby minimizing obstruction of the video of the broadcast by the electronic menu display.

17. The computer readable medium as set forth in claim 16, wherein each function is identified by a plurality of components, at least one of the plurality of identifying components having a high level of transparency.

18. The computer readable medium as set forth in claim 16, wherein each of said plurality of icons has the least transparent level of transparency.

19. The computer readable medium as set forth in claim 18, wherein a verbal description is displayed along with each of said plurality of icons, said verbal description having the least transparent level of transparency.

* * * * *

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(19) **United States**
(12) **Reissued Patent**
Tsukamoto et al.

(10) **Patent Number: US RE38,055 E**
(45) **Date of Reissued Patent: Apr. 1, 2003**

(54) **VIDEO DATA BUS COMMUNICATION SYSTEM AND METHOD**

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(73) Assignee: **Sony Corporation**, Tokyo (JP)

(21) Appl. No.: **09/461,136**

(22) Filed: **Dec. 14, 1999**

Related U.S. Patent Documents

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(64) Patent No.: **5,699,426**
Issued: **Dec. 16, 1997**
Appl. No.: **08/448,254**
Filed: **May 23, 1995**

(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**[7] **H04N 7/162**; H04L 9/00
(52) **U.S. Cl.** **380/240**; 380/242
(58) **Field of Search** 380/200, 210, 380/223, 226, 231, 232, 236, 259, 277, 278–287, 239–242, 255; 713/150, 151, 152, 153, 162, 163

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JP	7-162832	6/1995

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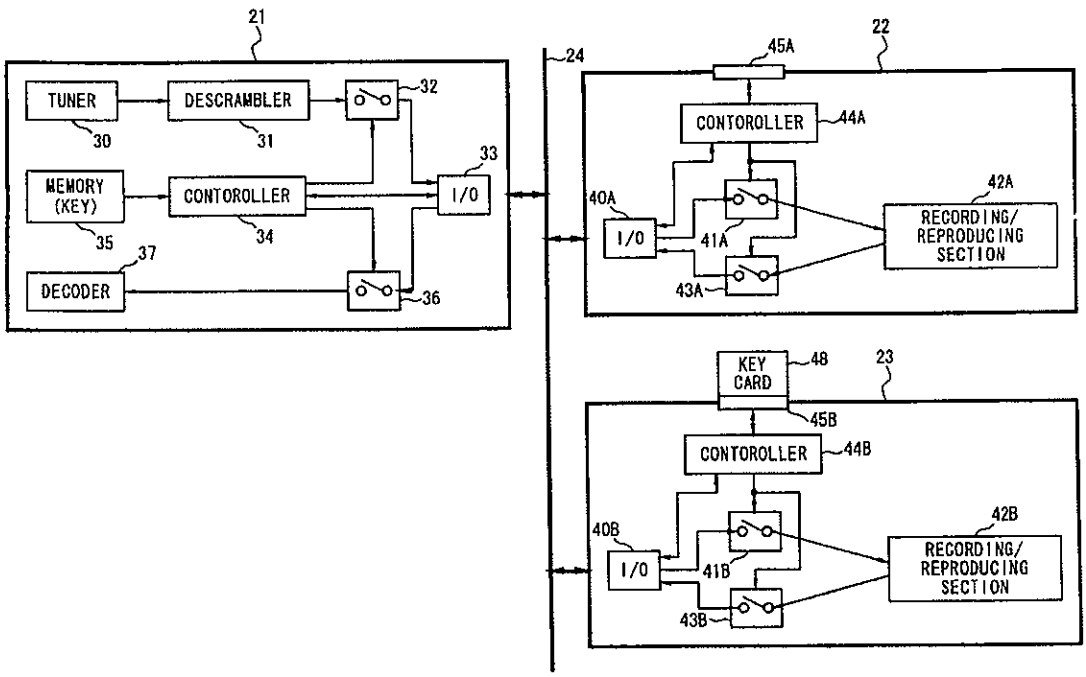
Primary Examiner—Bernarr E. Gregory
(74) *Attorney, Agent, or Firm*—Frommer Lawrence & Haug LLP; William S. Frommer; Gordon Kessler

(57) **ABSTRACT**

A video data communication system and method are disclosed which provides for the secure transmission of video data among devices connected to a video data bus. The video data is transmitted with address information corresponding to a particular device or, alternatively, video data is encrypted and transmitted on the data bus without address information.

66 Claims, 10 Drawing Sheets



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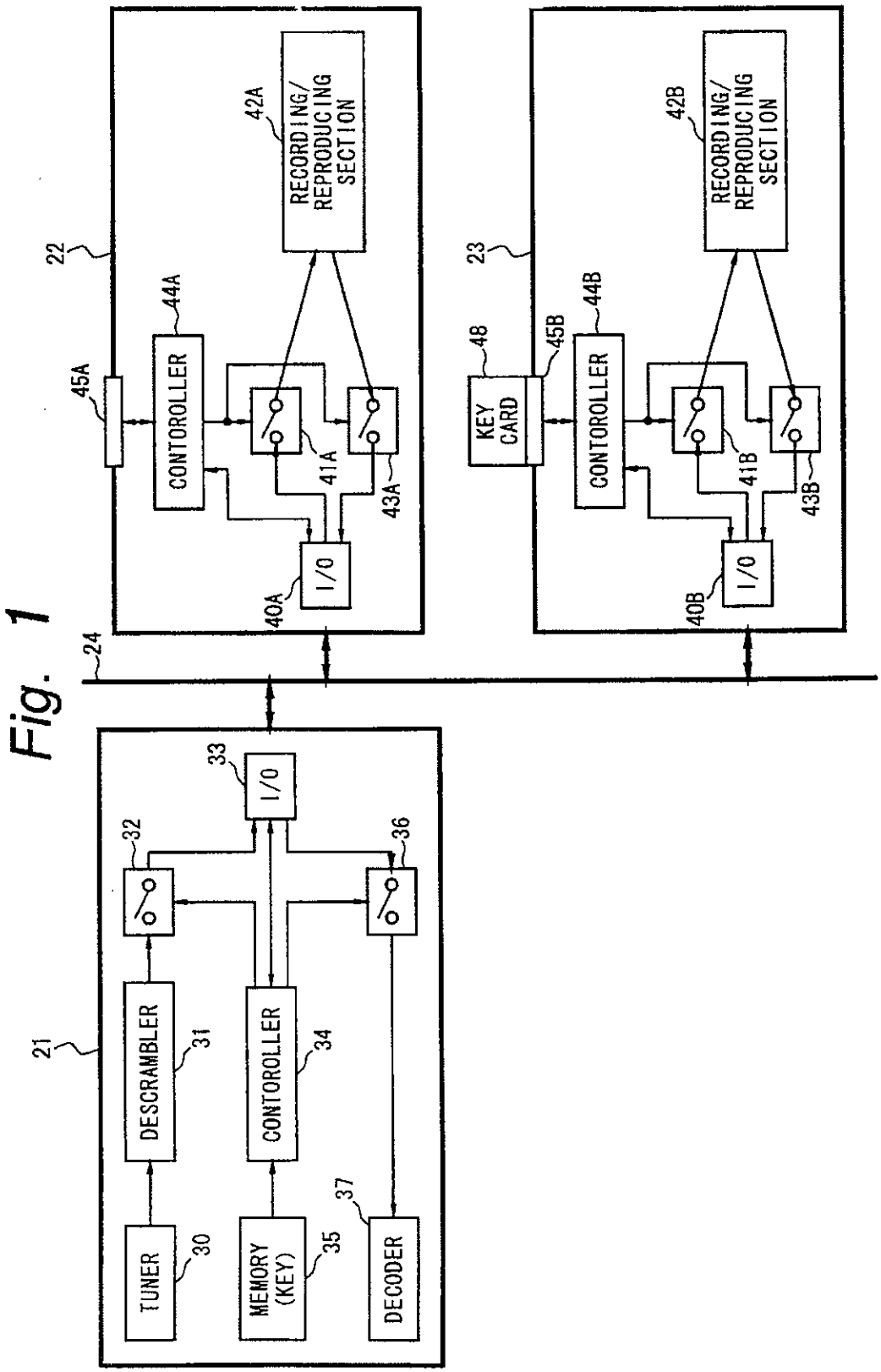

Fig. 1

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Fig. 2A

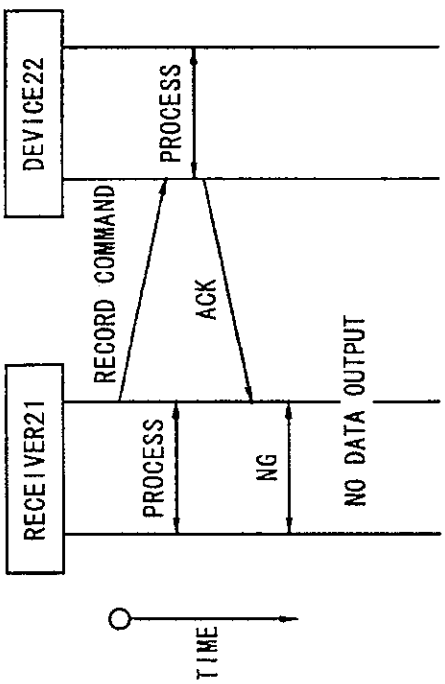


Fig. 2B

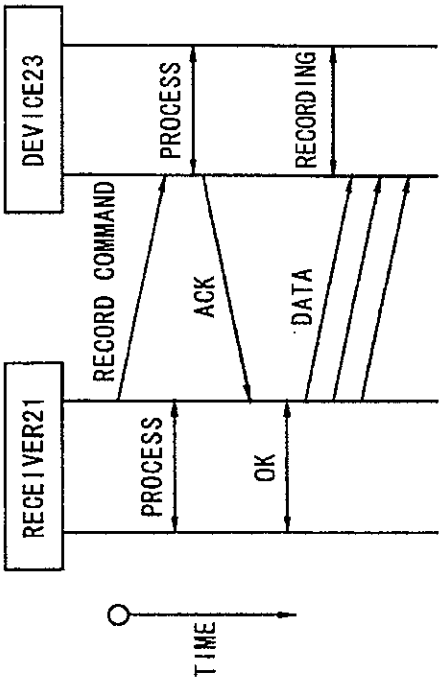


Fig. 2C

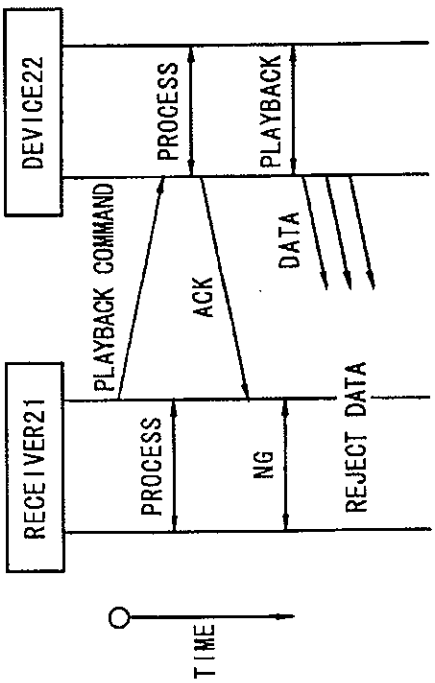
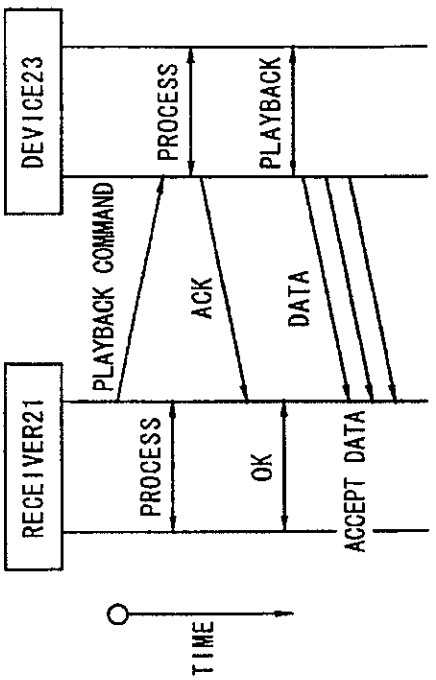


Fig. 2D



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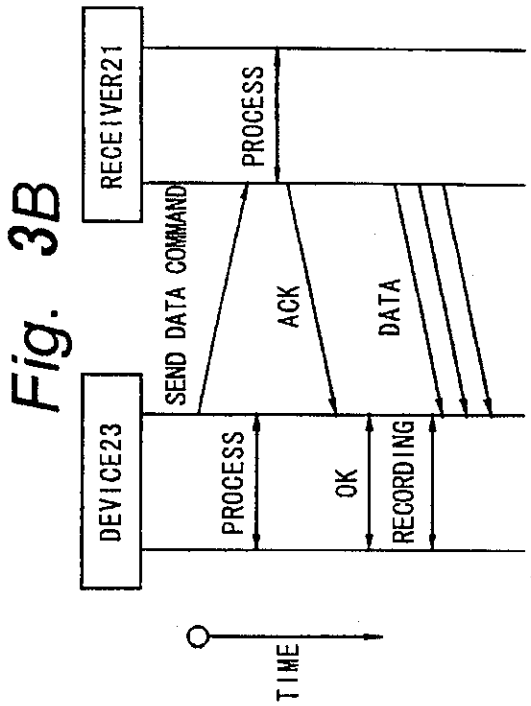

Fig. 3B

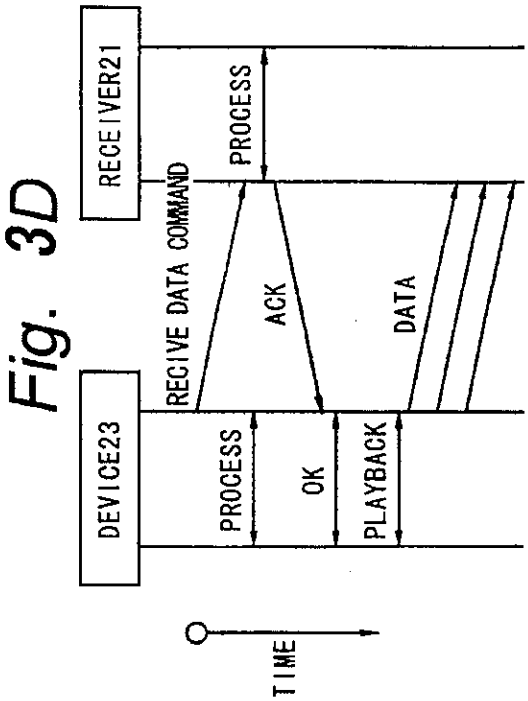

Fig. 3D

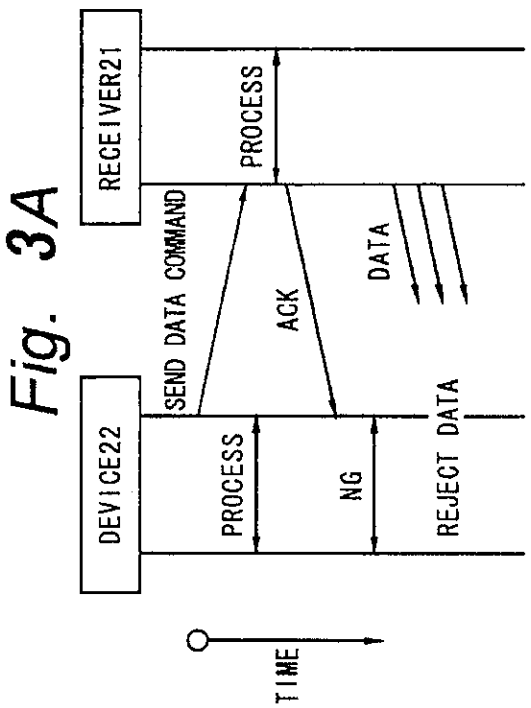

Fig. 3A

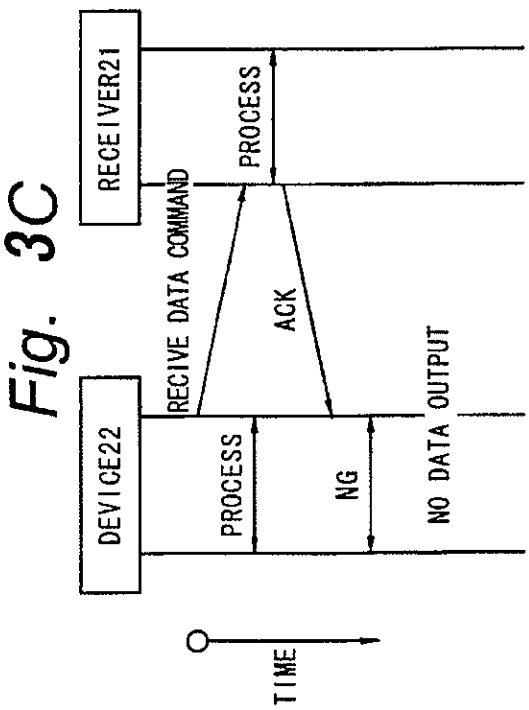

Fig. 3C

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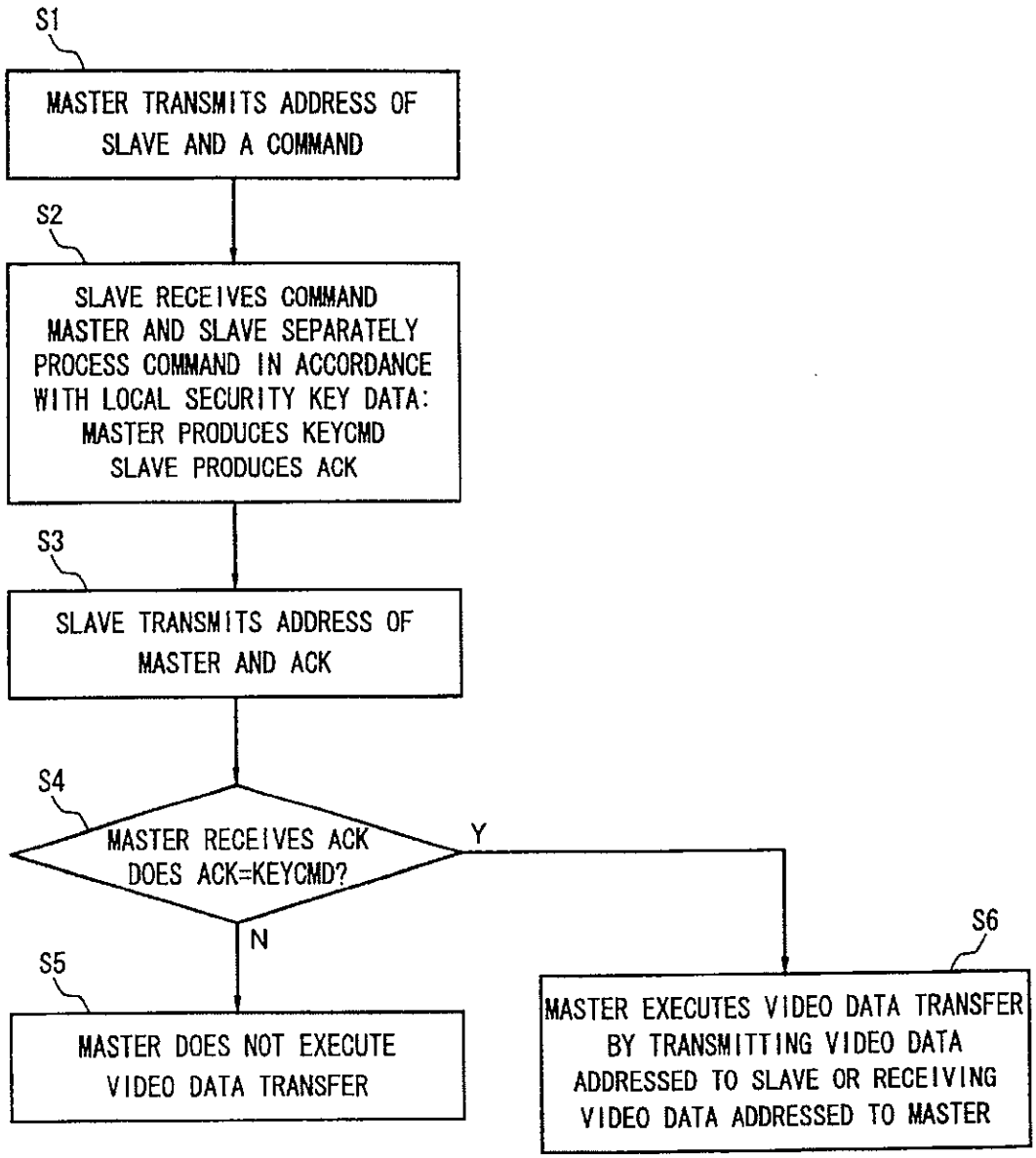
Fig. 4



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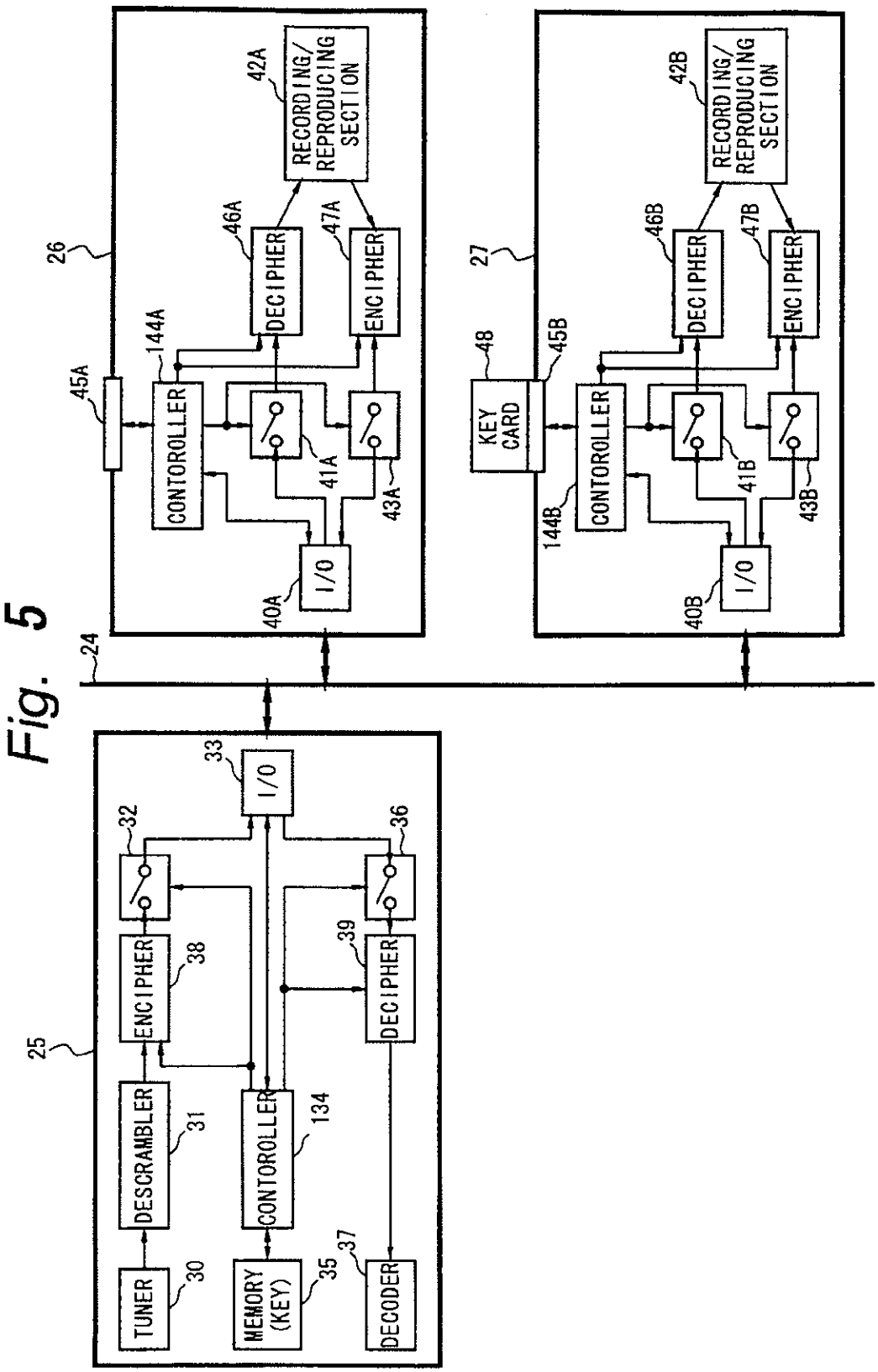

Fig. 5

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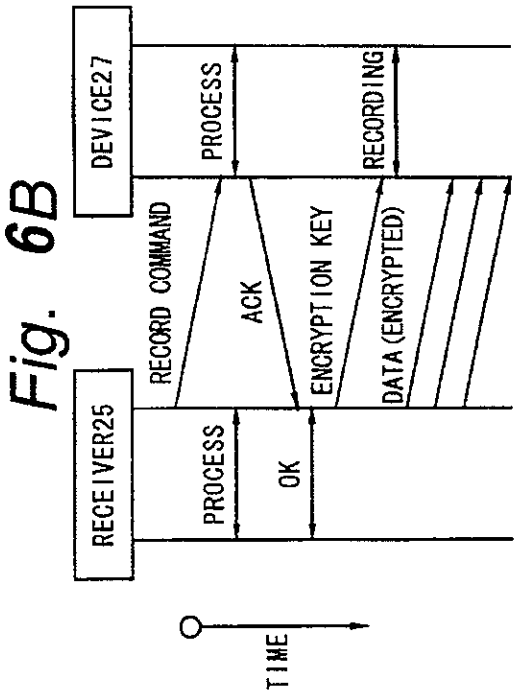

Fig. 6B

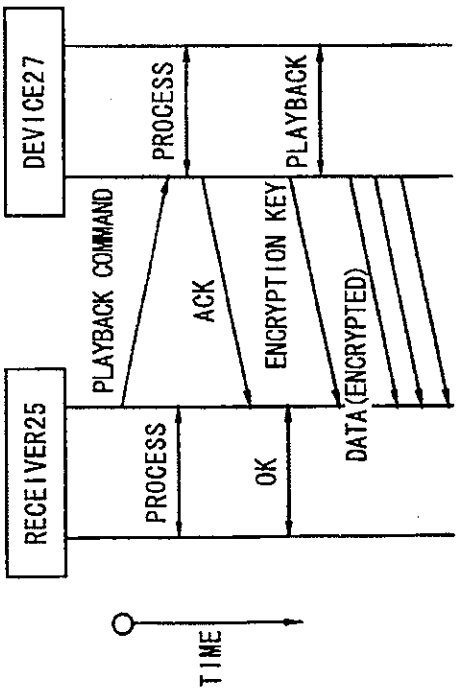

Fig. 6D

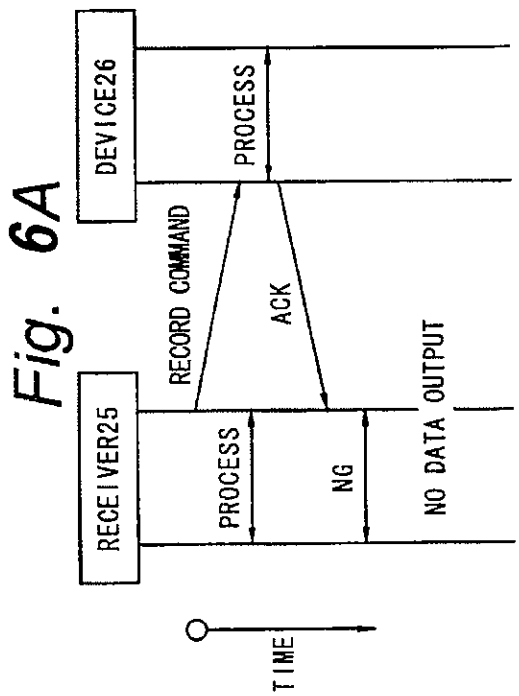

Fig. 6A

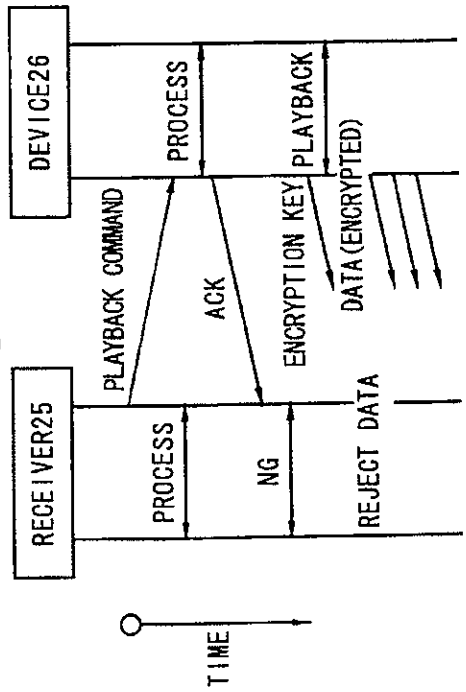

Fig. 6C

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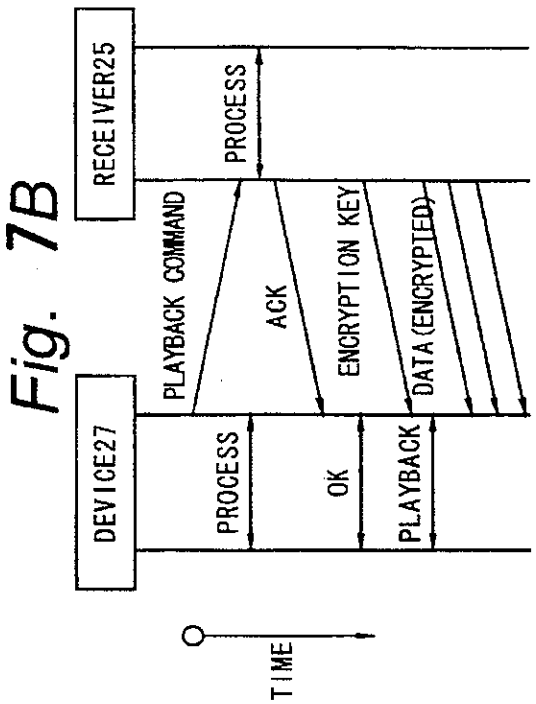

Fig. 7B

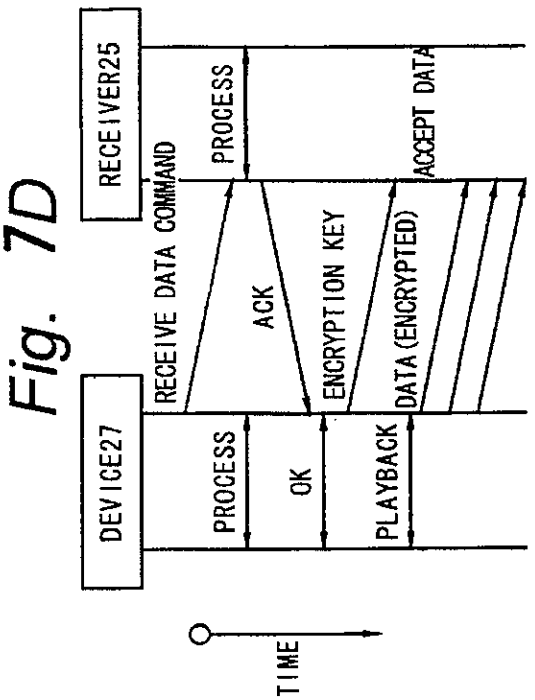

Fig. 7D

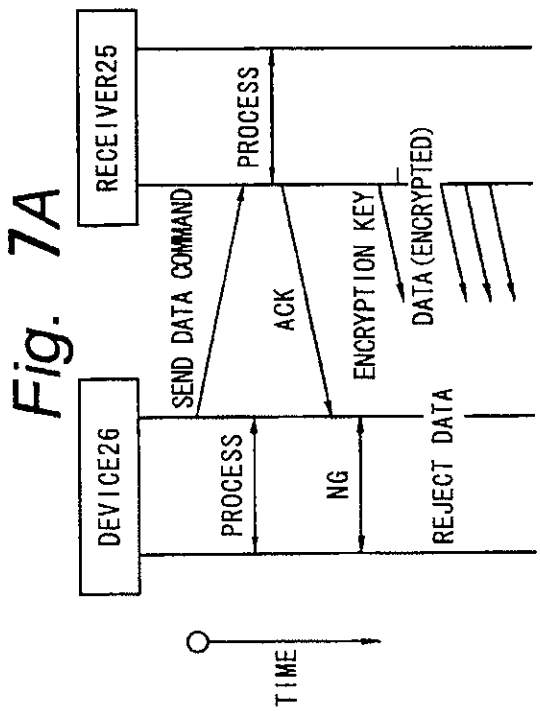

Fig. 7A

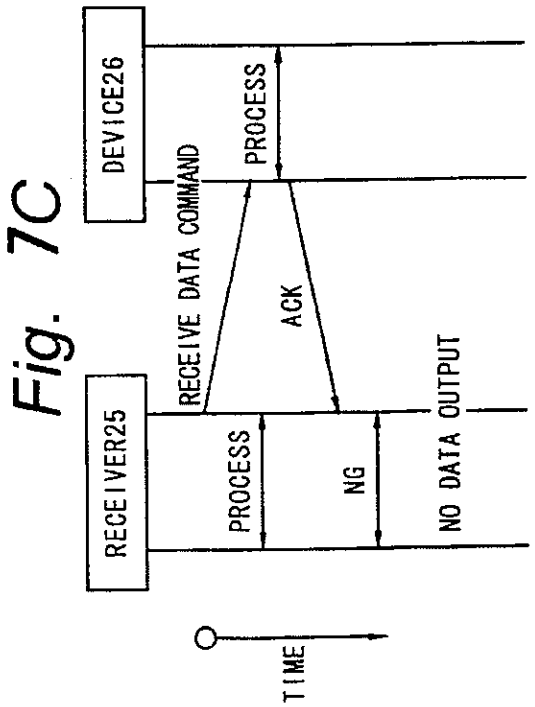

Fig. 7C

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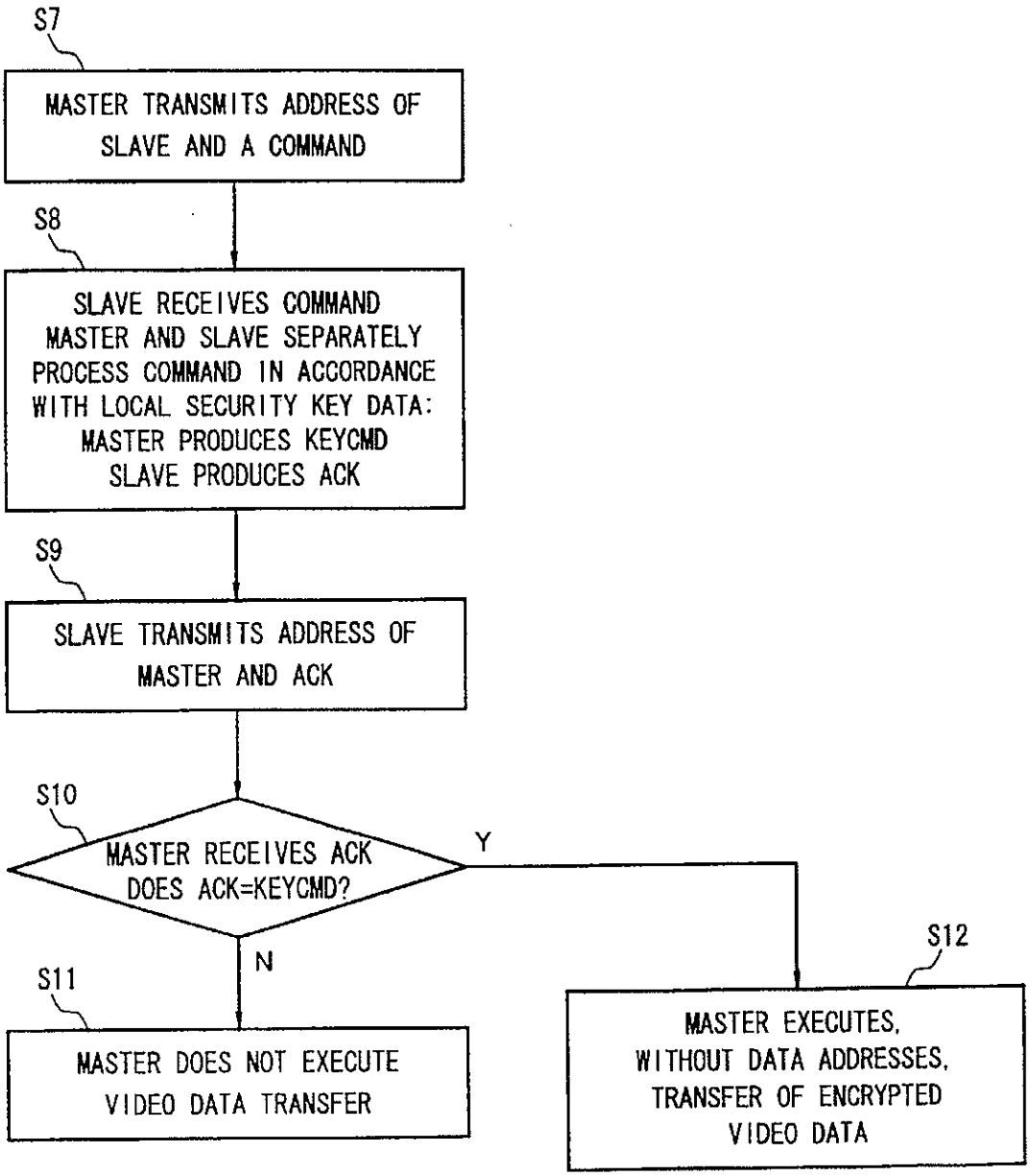
Fig. 8



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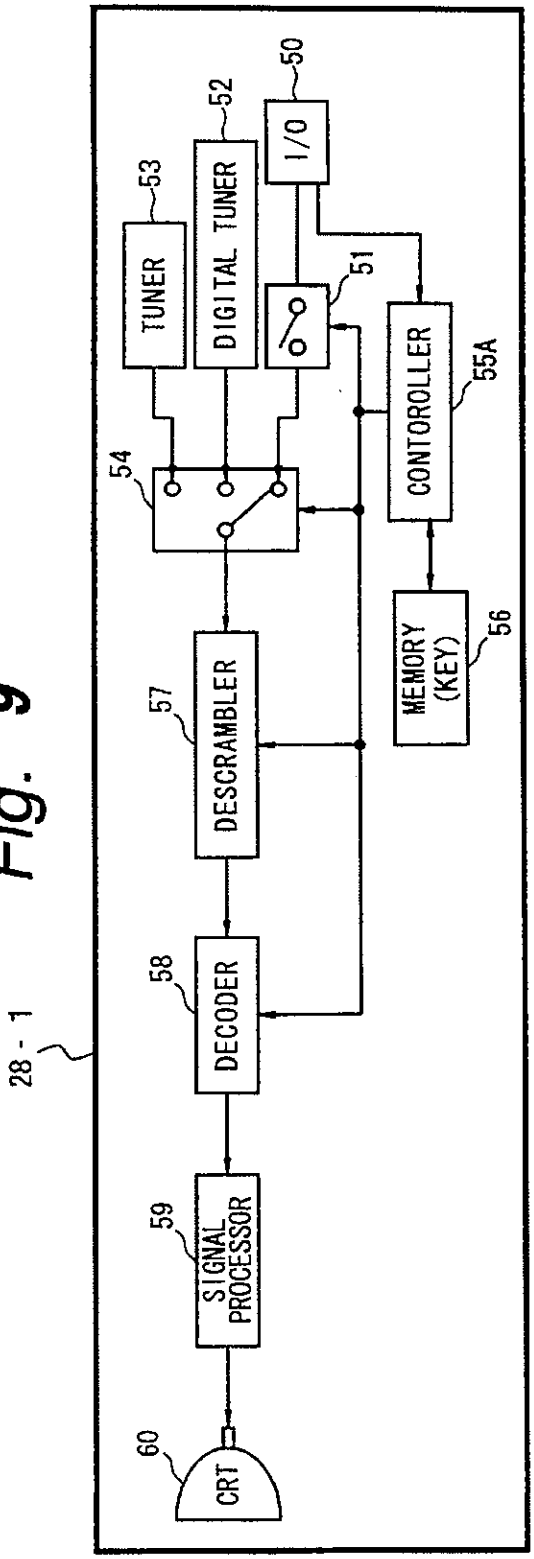

Fig. 9

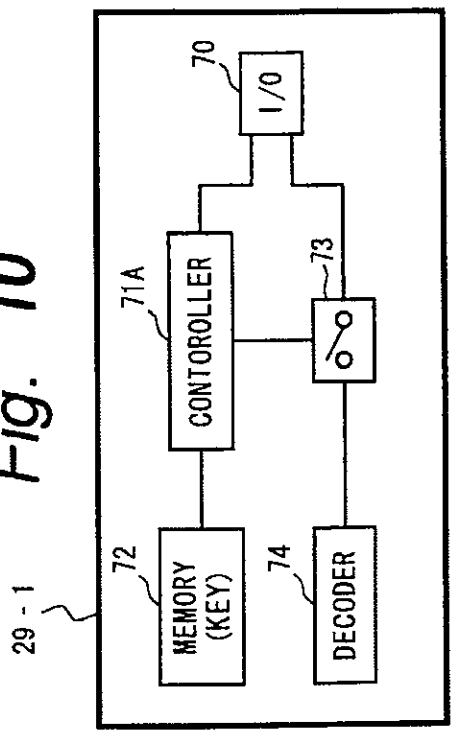

Fig. 10

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Fig. 11

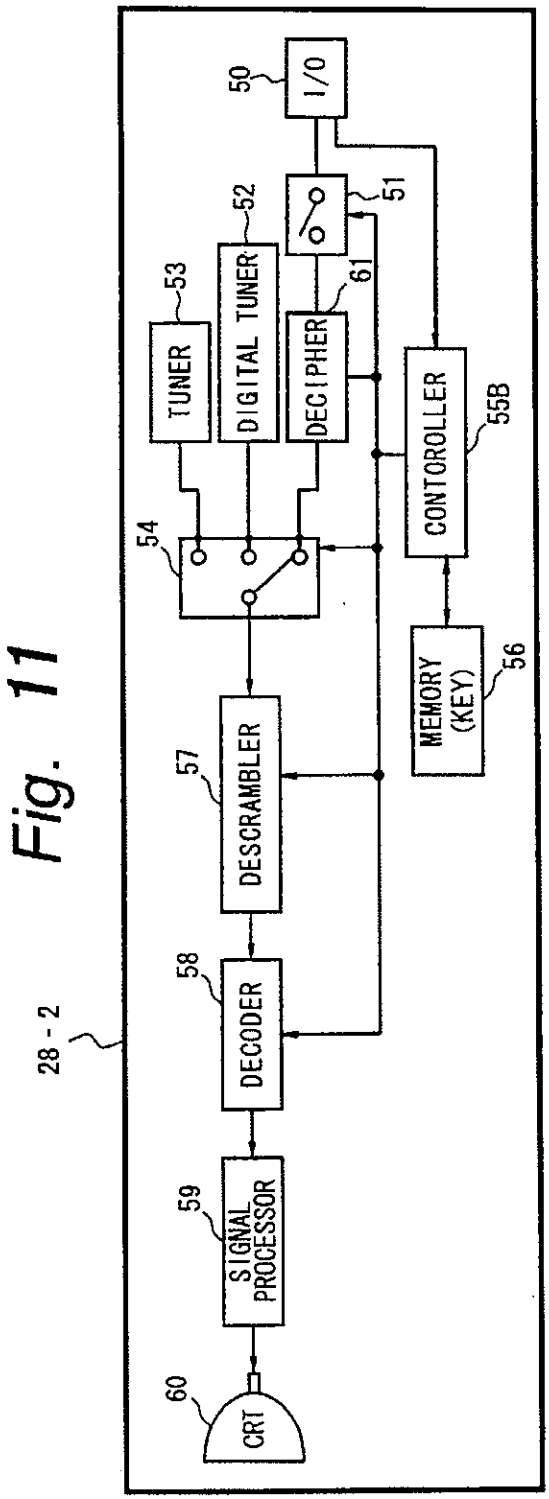
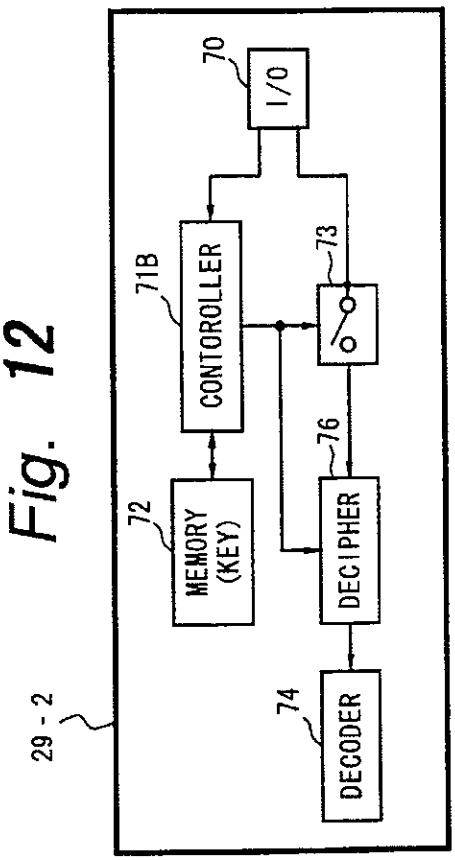


Fig. 12



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VIDEO DATA BUS COMMUNICATION SYSTEM AND METHOD

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a video data communication system and method in which video data is transmitted between devices connected to a data bus according to a protocol which ensures the security of the transmitted video data.

2. Description of the Related Art

Video data devices are connected to a common data bus to facilitate the communication of video data among the devices. Such devices include video signal receivers, video signal decoders, video signal recorders, video signal processing devices, video signal display devices, and video signal reproducing or playback devices. The data bus architecture has the advantage of being easy to implement, modify, and expand.

A video data bus system which conveys digital video data signals has the added advantage of substantially preserving the integrity of digital video signals transmitted on the bus. Such a system may transmit video data at great speeds without degrading the quality of the transmitted signal. Such a system is particularly useful for reproducing and disseminating copyrighted video data.

To preserve the value of copyrighted video data, a data bus communication system is needed that can selectively prevent certain devices connected to the bus from accessing certain video data but allowing such devices to access other video data. Also, a flexible communication protocol is needed to facilitate the secure and organized flow of video data through a video data bus system.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide a communication system in which the security of video data transmitted on a data bus is maintained.

Another object of the present invention is to prevent the unauthorized retrieval, reproduction, or display of video data transmitted on a video data bus.

Yet another object of the present invention is to provide a method for securely communicating video data among particular devices connected to a common video data bus.

A further object of the invention is to provide a communication system in which a device connected to a common data bus is able to address particular other devices for the transfer of video data thereamong.

A still further object of the invention is to provide a communication system in which devices connected to a common data bus can issue control signals to other devices to initiate specific types of video data transfers.

Another object of the present invention is to provide a communication system in which video data signals are transmitted on a video data bus without specifically included address signals.

In accordance with one aspect of the present invention, a method for communicating video data via a data bus between a master device and a slave device which are each coupled to the bus, comprises the steps of transmitting a slave address of the slave device and a command from the said master device to said data bus, generating, at said master device, a KEYCMD signal as a function of said command and a master security key, receiving, at said slave device from said data bus, said slave address and said command and recognizing said slave address as corresponding to said slave device, generating, at said slave device, an ACK signal as a function of said command and a slave security key, transmitting from said slave device to said data bus a master address of said master device and said ACK signal, receiving, at said master device from said data bus, said master address and said ACK signal and recognizing said master address as corresponding to said master device, comparing said KEYCMD signal generated by said master device with said ACK signal received by said master device, and executing a data transfer between said master device and said slave device if said KEYCMD signal corresponds to said ACK signal.

In accordance with another aspect of the present invention, in a system for communicating video data between at least one master device having a master address and at least one slave device having a slave address by way of a data bus coupled to said master device and to said slave device; said master device includes means for transmitting to said data bus said slave address and a command, means for generating a KEYCMD signal as a function of said command and a master security key, means for receiving from said data bus said master address, and an ACK signal, means for recognizing said master address as corresponding to said master device, means for comparing said KEYCMD signal and said ACK signal, and means for receiving said video data from said data bus if said KEYCMD signal corresponds to said ACK signal; and said slave device includes means for receiving from said data bus said slave address and said command, means for recognizing said slave address as corresponding to said slave device, means for generating said ACK signal as a function of said command and a slave security key, and means for transmitting to said data bus said master address, said ACK signal, and said video data.

In accordance with still another aspect of this invention, in a system for communicating video data between at least one master device having a master address and at least one slave device having a slave address by way of a data bus coupled to said master device and to said slave device; and said master device includes means for transmitting to said data bus said slave address and a command, means for generating a KEYCMD signal as a function of said command and a master security key, means for receiving from said data bus said master address and an ACK signal, means for recognizing said master address as corresponding to said master device, means for comparing said KEYCMD signal and said ACK signal, and means for transmitting to said data bus said video data if said KEYCMD signal corresponds to said ACK signal; and said slave device includes means for receiving from said data bus said slave address, said command and said video data, means for recognizing said slave address as corresponding to said slave device, means for generating said ACK signal as a function of said command and a slave security key, and means for transmitting to said data bus said master address and said ACK signal.

In accordance with a feature of this invention, in executing a data transfer, the data in said master device is encrypted according to an encryption key and the data in said slave device is decrypted according to said encryption

key, and said slave address and said encryption key are transmitted from said master device to said data bus and said encryption key and said slave address are received at said slave device from said data bus with said slave address being recognized as corresponding to said slave device. Alternatively, in executing a data transfer, the data in said slave device is encrypted according to an encryption key and said data in said master device is decrypted according to said encryption key, said master address and said encryption key are transmitted from said slave device to said data bus and said mater address and said encryption key are received from said data bus at said master device with said master address being recognized as corresponding to said master device.

The above, and other objects, features and advantages of the present invention will become apparent from the following detailed description of illustrative embodiments when read in conjunction with the accompanying drawings in which the same components are identified by the same reference numerals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a video data communication system according to a first embodiment of the present invention;

FIGS. **2**(a)–(d) are process timing diagrams to which reference will be made in explaining the operation of the video data communication system of FIG. **1**;

FIGS. **3**(a)–(d) are process timing diagrams to which reference will be made in explaining the operation of the video data communication system of FIG. **1**;

FIGS. **3**(a)–(d) are additional process timing diagrams to which reference will be made in explaining the operation of the video data communication system of FIG. **1**;

FIG. **4** is a flow diagram to which reference will be made in explaining the general sequence of communication and processing conducted by the video data communication system of FIG. **1**;

FIG. **5** is a schematic diagram of a video data communication system according to a second embodiment of the present invention;

FIGS. **6**(a)–(d) are process timing diagrams to which reference will be made in explaining the operation of the video data communication system of FIG. **5**;

FIGS. **7**(a)–(d) are additional process timing diagrams to which reference will be made in explaining the operation of the video data communication system of FIG. **5**;

FIG. **8** is a flow diagram to which reference will be made in explaining the general sequence of communication and processing conducted by the video data communication system of FIG. **5**;

FIG. **9** is a schematic diagram of a display device compatible with the video data communication system of FIG. **1**;

FIG. **10** is a schematic diagram of a decoding device compatible with the video data communication system of FIG. **1**;

FIG. **11** is a schematic diagram of a display device compatible with the video data communication system of FIG. **5**; and

FIG. **12** is a schematic diagram of a decoding device compatible with the video data communication system of FIG. **5**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of the video data communication system according to the present invention is illustrated in FIG. **1**. As explained in the following, it is preferred that the video data communication system be specifically adapted to receive, process, and transmit digital video data. Nevertheless, it should be appreciated that this system can be modified to accommodate other digital data or analog signals without departing from the scope of the invention. As it is understood that the system can easily be implemented to accommodate other types of data, the following is specifically directed towards a digital video data communication system to simplify explanation of the invention.

The video data communication system is generally comprised of a receiver **21**, a data bus **24**, and one or more peripheral devices. The peripheral devices, depending on their particular configurations, may transmit and/or receive control signals and/or video data through data bus **24**. Two such peripheral devices are illustrated in FIG. **1**, specifically, a recording/reproducing device **22** and a recording/reproducing device **23**. Each of receiver **21**, device **22**, and device **23** are connected to data bus **24** and are capable of transmitting and receiving control signals and video data through data bus **24**.

Receiver **21** is suited for receiving, descrambling, and decoding an input digital video signal. Specifically, receiver **21** is comprised of a tuner **30**, a descrambler **31**, a switch **32**, an input/output port **33**, a controller **34**, a memory **35**, a switch **36**, and a decoder **37**. Preferably, the input digital video signal is a satellite broadcast digital video signal acquired by a satellite antenna system. Alternatively, the input digital video signal is acquired from any of a number of other transmission media, such as a land-based broadcast system, a cable television system, or a fiber optic network.

Tuner **30** receives an input digital video signal (not shown) and selects a particular digital video signal or channel therefrom. Preferably, tuner **30** can be controlled by a user to select among a number of different video signals. Tuner **30** is coupled to descrambler **31**, and provides a selected digital video signal thereto.

Descrambler **31** descrambles a scrambled digital video signal. As is well known in the art, transmitted video signals are commonly scrambled or coded by a signal provider to prevent unauthorized reception of the video signal. Descrambler **31** descrambles, as needed, the selected digital video signal provided by tuner **30** and provides an unscrambled version of the digital video signal to switch **32**. In an alternate embodiment, a direct connection (not shown) between descrambler **31** and decoder **37** is provided to carry the unscrambled signal directly to decoder **37**.

Switch **32** is coupled to descrambler **31**, controller **34**, and input/output (I/O) port **33**. In accordance with a switch signal provided by controller **34**, switch **32** closes to connect descrambler **31** with I/O port **33**. Switch **36** is connected to decoder **37**, controller **34**, and I/O port **33**. In accordance with another switch signal provided by controller **34**, switch **36** closes to connect decoder **37** with I/O port **33**. I/O port **33** is further coupled to data bus **24** and controller **34**.

Through closed switch **36**, decoder **37** receives a coded digital video signal from I/O port **33**. As is well known in the art, video signals are commonly compressed or otherwise coded to facilitate their transmission through a transmission medium. Decoder **37** decodes, as needed, a coded digital video signal to produce an uncoded digital video signal. Decoder **37** provides the uncoded digital video signal to a video display device (not shown) for display to a user. It is preferred that decoder **37** is adapted to decode digital video signals encoded in accordance with the Moving Picture Image Coding Experts Group (MPEG) standard.

Memory 35 is a storage device for storing one or more security keys. Memory 35 is coupled to controller 34 and stores or provides security keys and other data as required by controller 34. In response to commands provided by a user, or according to a pre-stored set of instructions, controller 34 transmits or receives address, control and data signals, through I/O port 33, to or from data bus 24. By manipulating switch signals provided to switches 32 and 36, controller 34 controls the flow of digital video data through I/O port 33. In an alternate embodiment, controller 34 further controls the operation of I/O port 33 directly with I/O port control signals and monitors data flowing through I/O port 33.

Recording/reproducing device 22 is comprised of an I/O port 40A, a switch 41A, a recording/reproducing section 42A, a switch 43A, a controller 44A, and a card port 45A. I/O port 40A is coupled to data bus 24, controller 44A, switch 41A, and switch 43A. (I/O port 40A routes address, control, and data signals to and from data bus 24 and controller 44A. I/O port 40A routes data signals to switch 41A and routes data signals from switch 43A. In an alternate embodiment, address and control signals are also routed through I/O port 40A to or from switches 41A and 43A. Switch 41A is further coupled to controller 44A and section 42A. Similarly, switch 43A is further coupled to controller 44A and section 42A.

According to switch commands from controller 44A, switch 41A closes to connect I/O port 40A and section 42A. Also, according to switch commands from controller 44A, switch 43A closes to connect section 42A and I/O port 40A. Alternatively, switches 41A and 43A may be replaced with a single bi-directional switch (not shown) controlled by controller 44A and connecting I/O port 40A and section 42A.

Recording/reproducing section 42A records data supplied through switch 41A. Section 42A reproduces prerecorded data and supplies the reproduced data to switch 43A. Preferably, section 42A is a digital video tape recording/reproducing device (VTR).

Card port 45A is adapted to mechanically, electronically, or otherwise engage a key card 48 and to obtain security key data or other information therefrom. Key card 48, which is shown engaged in device 23 in FIG. 1, comprises an active or passive device, as is well known in the art. Card port 45A is coupled to controller 44A and facilitates the communication of signals between controller 44A and an engaged key card. While a key card is not installed in card port 45A, card port 45A responds to signals from controller 44A by returning a signal that is not a valid security key.

In response to commands provided by a user, or according to a pre-stored set of instructions controller 44A transmits to or receives from data bus 24, through I/O port 40A, address, control and data signals. By manipulating switch signals provided to switches 41A and 43A, controller 44A controls the flow of digital video data through I/O port 40A. In an alternate embodiment, controller 44A may control the operation of I/O port 40A directly with I/O port control signals and monitor data flowing through I/O port 40A.

As illustrated, device 23 is substantially the same as device 22, like elements being denoted by like reference numerals with the exception of the terminating letter A and B. Key card 48, shown attached to card port 45B of device 23, stores a valid security key corresponding to a security key stored in memory 35.

Operation of the first embodiment of the video data communication system will be described below. One of the most important features of this first embodiment is that each signal transmitted via data bus 24 is accompanied by an address signal corresponding to an address of a particular device, each device attached to data bus 24 having at least one address. Communication of signals between selected devices includes communication of an address of the device intended as the recipient of the transmitted signal. Each device connected to data bus 24 reads or writes, as appropriate, signals on data bus 24 when the device detects its own address on the bus. Signals accompanying addresses for other devices are ignored. In this manner, data are securely transferred between a transmitting device and a selected destination device.

This communication protocol allows for many different sequences of signal transfer between devices connected to data bus 24. Examples of these signal transfer sequences, implemented in different modes of operation of the present invention, will be described in detail below. In one mode of operation, broadcast digital video data signals are received by receiver 21 and transmitted to data bus 24 for display by a display device (not shown), for recording by a recording device, or for other signal processing. In another mode, prerecorded video data are reproduced by a peripheral device and transmitted to a decoding device for decoding and subsequent display. In still another mode, prerecorded video data are reproduced by one peripheral device and transmitted to another peripheral device which records the video data.

In a first broadcast display mode, receiver 21 receives a broadcast signal and suitably processes it for display by a video display (not shown). Tuner 30 selectively receives a broadcast signal and supplies the signal to descrambler 31. Descrambler 31 descrambles the broadcast signal and provides a descrambled version of the signal to switch 32. Controller 34 outputs switch signals that cause switches 32 and 36 to close and outputs I/O port control signals to cause I/O port 33 to couple switches 32 and 36 together. The descrambled video signal propagates through switch 32, I/O port 33, and switch 36, to decoder 37. Decoder 37 decodes the descrambled video signal and supplies the decoded signal to a video display (not shown). When a direct connection between descrambler 31 and decoder 37 is provided, the descrambled signal is supplied directly to decoder 37, bypassing switch 32, switch 36, and I/O port 33.

In a second broadcast display mode, receiver 21 receives a broadcast video signal and supplies the broadcast signal to a display device (not shown) connected to data bus 24. An example of such a display device is illustrated in FIG. 9 and will be described in detail in a later section. As in the first broadcast display mode, tuner 30 selectively receives a broadcast signal and provides the signal to descrambler 31. Descrambler 31 descrambles the broadcast video signal to produce a descrambled video signal. Controller 34 issues an address signal corresponding to a selected display device and a display command, and appropriately manipulates I/O port 33 to route the address signal an display command to data bus 24.

The display device (not shown in FIG. 1) reads the address on data bus 24, recognizes the address as its own, and reads the accompanying display command from data bus 24. The display device processes the display command to generate an ACK signal and transmits an address of receiver 21 along with the ACK signal to data bus 24. The address and ACK signal supplied by the display device are received by controller 34 via I/O port 33.

Controller 34 retrieves a security key from memory 35 and generates a KEYCMD signal as a function of the display

command and the retrieved security key. The KEYCMD signal is then compared to the received ACK signal. If the ACK signal is equal to the KEYCMD signal, then controller **34** transmits an address corresponding to the display device to data bus **24**. Controller **34** also issues a switch command to switch **32**, causing it to close, and an I/O post control signal to I/O port **33**, causing it to couple switch **32** with data bus **24**. Descrambled video signal transmitted from descrambler **31** propagates through switch **32** and I/O port **33** to data bus **24**.

The address signal on data bus **24** is recognized by the display device and the subsequently transmitted video data are received, processed, and displayed. Other peripheral devices connected to data bus **24** do not read the video data present on the bus if the address signal does not correspond to one of their own respective addresses.

In a recording mode of operation, receiver **21** receives a broadcast signal and transmits the broadcast signal via data bus **24** to a particular peripheral device which records the signal. Controller **34** configures I/O port **33** to couple controller **34** with data bus **24** and then transmits an address of a particular recording device along with a record command to data bus **24**. Assuming, for example, that the address transmitted corresponds to an address of device **22**, controller **44A**, through I/O port **40A**, reads the address on data bus **24**, recognizes the address as its own, and reads the accompanying record command from data bus **24**. Controller **44A** processes the record command to generate an acknowledge (ACK) signal.

Specifically, controller **44A** polls card port **45A** for a security key and generates an ACK signal as a function of the received record command and the signal returned by card port **45A**. Controller **44A** then transmits an address of receiver **21** and the ACK signal via I/O port **40A** to data bus **234**. The address and ACK signal supplied by device **22** are received by controller **34** via I/O port **33**.

Controller **34** retrieves a security key from memory **35** and generates a KEYCMD signal as a function of the record command and the retrieved security key. The KEYCMD signal is then compared to the received ACK signal. If the ACK signal is equal to the KEYCMD signal, then controller **34** transmits an address signal of the particular recording device to data bus **24** through I/O port **33** and configures switch **32** and I/O port **33** for the transmission of descrambled video data from descrambler **31** to data bus **24** to initiate the transfer of video data. If the ACK signal is not equal to the KEYCMD signal, then controller **34** issues a switch command signal, causing switch **32** to open, to prevent the flow of descrambled broadcast video data to data bus **24**.

Since, as illustrated in FIG. **1**, card port **45A** of device **22** is not coupled to a card key containing a correct security key, controller **44A** will generate an ACK signal which is not equal to the KEYCMD signal produced by controller **34** and no video data transfer will occur. Thus, the supply of descrambled broadcast video data to a particular recording device depends upon the installation of an appropriate key card in the card port of the particular device.

When device **23** is selected to record broadcast video data, controller **34** outputs an address of device **23** to data bus **24** through I/O port **33** along with a record command. Controller **44B**, through I/O port **40B**, reads the address on data bus **24**, recognizes the address signal as its own and reads the accompanying record command. Controller **44B** retrieves a security key from key card **48** via card port **45B**. Controller **44B** generates an ACK signal as a function of the received record command and the retrieved security key. Controller **44B** transmits an address of receiver **21** and the ACK signal to data bus **24** through I/O port **40B**.

As above, controller **34** reads the address signal and the ACK signal, generates a KEYCMD signal, and compares the ACK and KEYCMD signals. If the security key contained in key card **48** corresponds to the security key contained in memory **35**, the ACK signal and the KEYCMD signal are equal. Meanwhile, controller **44B** supplies a switch control signal to switch **41B**, causing it to close, thereby connecting I/O port **40B** with recording/reproducing section **42B**. Further, I/O port **40B** is configured to route video data from data bus **24** to section **42B**. After verifying that the two security keys correspond, controller **34** facilitates the transmission of an address of device **23** and descrambled broadcast video data to device **23**.

Controller **44B**, through I/O port **40B**, reads the address on data bus **24** and recognizes the address signal as its own. The accompanying descrambled video data on data bus **24** is retrieved and passed through I/O port **40B** and switch **41B** to section **42B** for recording. As a result, recording devices having the selected address and provided with a key card **48** having the correct security key retrieve and record video data supplied by receiver **21**.

In a playback mode of operation, receiver **21** initiates the playback of prerecorded video data from a peripheral device. Controller **34** transmits an address signal, corresponding to an address of a particular peripheral device, along with a playback command to data bus **24** through I/O port **33**. Assuming, for example, that the address signal corresponds to an address of device **22**, controller **44A**, through I/O port **40A**, reads the address on data bus **24**, recognizes the address as its own, and reads the accompanying playback command from data bus **24**. As described previously, controller **44A** generates an ACK signal as a function of the playback command and a signal provided by card port **45A**. controller **44A** then transmits an address of receiver **21** and this ACK signal via I/O port **40A** to data bus **24**. Controller **44A** also issues a switch control signal to switch **43A**, causing it to close, and configures I/O port **40A** to connect data bus **24** and switch **43A**.

Controller **34**, through I/O port **33**, reads the address on data bus **24**, recognizes the address as its own, and reads the accompanying ACK signal. Controller **34** retrieves a security key from memory **35** and generates a KEYCMD signal as a function of the playback command and the retrieved security key. The received ACK signal is compared to the KEYCMD signal and, if they are equal, controller **34** issues a switch control signal to switch **36**, causing it to close, and issues an I/O port control signal to I/O port **33**, causing it to route signals from data bus **24** to switch **36**. However, if the ACK signal does not equal the KEYCMD signal, then controller **34** issues a switch control signal which causes switch **36** to open.

Since device **22**, as shown in FIG. **1**, is not engaged with a key card having a correct security key, the ACK signal it produces will not be equivalent to the KEYCMD signal produced by controller **34**. Even though recording/reproducing section **42A** may output prerecorded video data to data bus **24** via switch **43A** and I/O port **40A**, the data will not reach decoder **37**, since switch **36** will have been opened.

In the case where controller **34** initially issues an address corresponding to device **23**, controller **44B** reads and recognizes the address, reads the accompanying playback command, and polls card port **45B**. Key card **48**, having a security key corresponding to that stored in memory **35**,

supplies the security key to controller 44B through card port 45B. Controller 44B generates an ACK signal as a function of the received layback command and the security key received from key card 48. The ACK signal and the address of receiver 21 are transmitted via data bus 24 to controller 34 and switch 43B is closed. Controller 34 reads and recognizes the address, reads the accompanying ACK signal, and generates a KEYCMD signal as a function of the playback command and a security key obtained from memory 35. In this instance, the ACK signal and the KEYCMD signal are equal, and accordingly, controller 34 causes switch 36 to close.

Controller 44B outputs an address of receiver 21 and recording/reproducing section 42B outputs a prerecorded video data signal to data bus 24. Controller 34 reads and recognizes the address. The accompanying video data signal is retrieved from data bus 24 and supplied through I/O port 33 and switch 36 to decoder 37. Decoder 37 decodes the prerecorded video data signal and supplies the decoded signal to a video display device (not shown). Receiver 21 thus decodes data reproduced by a peripheral device in which a key card having a correct security key is installed.

The signal processing and exchange of messages in receiver-initiated data transfers is summarized in FIGS. 2(a)–(d). In each of FIGS. 2(a)–(d), the time axis runs positive in the direction indicated by the arrow. Although not explicitly mentioned in the following discussion, it should be understood that each communication between devices includes an address of the device to which the communication is being sent.

FIG. 2(a) illustrates the interaction between receiver 21 and device 22 of FIG. 1 when receiver 21 initiates video data recording. In FIG. 2(a) receiver 21 first issues a record command to device 22. Receiver 21 then processes the record command in conjunction with a security key retrieved from memory 35 to produce a KEYCMD signal. Device 22 receives the record command and similarly processes it in conjunction with a security key retrieved from card port 45A to produce an ACK signal. Device 22 then transmits the ACK signal to receiver 21. Receiver 21 compares the received ACK signal with the KEYCMD signal to determine if they are equal. Since a key card having a correct security key is not installed in device 22, the KEYCMD signal and the ACK signal are not equal. As a result, receiver 21 determines that the ACK signal is "no good" (NG) and no data is output by receiver 21.

In FIG. 2(b), receiver 21 transmits a record command to device 23. As in the manner previously described, both receiver 21 and device 23 process the recording command to produce, respectively, a KEYCMD signal and an ACK signal. Device 23 transmits the ACK signal to receiver 21. Receiver 21 compares the KEYCMD signal and the received ACK signal. Since device 23 is engaged with a key card having a correct security key, the ACK signal and the KEYCMD are equal. Receiver 21 determines that the ACK signal is thus "OK" and initiates the transmission of video data to device 23. Device 23 records the video data it receives.

FIGS. 2(c) and 2(d) illustrate the sequence of steps which occur when receiver 21 issues a playback command to a peripheral device. In FIG. 2(c), receiver 21 transmits a playback command to device 22. Receiver 21 processes the playback command in conjunction with a security key retrieved from memory 35 to produce a KEYCMD signal. Device 22 processes the received playback command in conjunction with a security key retrieved from card port 45A to produce an ACK signal. Device 22 transmits the ACK signal to receiver 21. Receiver 21 compares the KEYCMD signal with the received ACK signal to determine if they are equal. Since a key card containing a correct security key is not installed in device 22, the ACK signal is not equal to the KEYCMD signal. Accordingly, receiver 21 determines that the ACK signal is "no good" (NG). Nonetheless, device 22 reproduces a prerecorded video signal and transmits the reproduced video data to receiver 21. Receiver 21 rejects the video data.

In FIG. 2(d), receiver 21 transmits a playback command to device 23. Receiver 21 process the playback command, as before, to produce a KEYCMD signal. Device 23 processes the received playback command in conjunction with a security key retrieved from card port 45B to produce an ACK signal. Device 23 transmits this ACK signal to receiver 21. Receiver 21 compares the KEYCMD signal to the received ACK signal to determine if they are equal. Since key card 48 is engaged in device 23 and key card 48 contains a valid security key, the ACK signal and the KEYCMD signal are equal. Accordingly, receiver 21 determines that the ACK signal is "OK". Device 23 reproduces a prerecorded video signal and transmits the reproduced video data to receiver 21. Receiver 21 accepts the video data from device 23 and decodes it, as described with reference to FIG. 1.

The signal processing and exchange of messages in peripheral device-initiated data transfers is summarized in FIGS. 3(a)–(d). In each of FIGS. 3(a)–(d), the time axis runs positive in the direction indicated by the arrow. Each communication between the devices includes an address of the device to which the communication is being sent.

FIGS. 3(a) and 3(c) illustrate the interaction between device 22 and receiver 21 of FIG. 1 when device 22 initiates the transfer of video data. In FIG. 3(a), device 22 first issues a send data command to receiver 21. Device 22 then processes the send data command in conjunction with a security key retrieved from card port 45A to produced a KEYCMD signal. Receiver 21 receives the send data command and similarly processes it in conjunction with a security key retrieved from memory 35 to produce an ACK signal. Receiver 21 then transmits the ACK signal to device 22. Device 22 compares the received ACK signal with the KEYCMD signal to determine if they are equal. Since a key card having a correct security key is not installed in device 22, the KEYCMD signal and the ACK signal are not equal. As a result, device 22 determines that the ACK signal is "no good" (NG). Nonetheless, receiver 21 attempts to transmit broadcast video data to device 22. Device 22 rejects the video data.

In FIG. 3(c), device 22 first transmits a receive data command to receiver 21. Device 22 then processes the receive data command in conjunction with a security key retrieved from card port 45A to produce a KEYCMD signal. Receiver 21 receives the receive data command and similarly processes it in conjunction with a security key retrieved from memory 35 to produce an ACK signal. Receiver 21 then transmits the ACK signal to device 22. Device 22 compares the received ACK signal with the KEYCMD signal to determine if they are equal. Since a key card having a correct security key is not installed in device 22, the KEYCMD signal and the ACK signal are not equal. As a result, device 22 determines that the ACK signal is "no good" (NG) and no data is output by device 22.

FIGS. 3(b) and 3(d) each illustrate the sequence of operations that occur when device 23 issues a command to

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receiver 21. In FIG. 3(b), device 23 first transmits a send data command to receiver 21. Device 23 processes the send data command in conjunction with a security key retrieved from card port 45B to produce a KEYCMD signal. Receiver 21 processes the send data command in conjunction with a security key retrieved from memory 35 to produce an ACK signal. Receiver 21 then transmits the ACK signal to device 23. Device 23 compares the KEYCMD signal with the received ACK signal to determine if they are equal. Since key card 48 is engaged in device 23 and key card 48 contains a valid security key, the ACK signal and the KEYCMD signal are equal. Accordingly, device 23 determines that the ACK signal is "OK". Receiver 21 transmits video data to device 23 which records the video data.

In FIG. 3(d), device 23 first transmits a receive data command to receiver 21. Device 23 processes the receive data command in conjunction with a security key retrieved from card port 45B to produce a KEYCMD signal. Receiver 21 processes the receive data command in conjunction with a security key retrieved from memory 35 to produce an ACK signal Receiver 21 then transmits the ACK signal to device 23. Device 23 compares the KEYCMD signal with the received ACK signal to determine if they are equal. Since key card 48 is engaged in device 23 and key card 48 contains a valid security key, the ACK signal and the KEYCMD signal are equal. Accordingly, device 23 determines that the ACK signal is "OK". Device 23 reproduces a prerecorded video signal and transmits the reproduced video data to receiver 21. Receiver 21 accepts the video data from device 23 and processes it, as described above.

In a dubbing mode, two peripheral devices, each installed with a key card having the same security key, reproduce and record, respectively, prerecorded video data. A master peripheral device initiates a video data transfer by transmitting to data bus 24 an address of a slave peripheral device along with a record command or a playback command. As described in the preceding, the slave device reads and recognizes the address, configures itself according to the command, and returns an address and an ACK signal. As also described in the preceding, the master device reads and recognizes the address and processes the ACK signal to determine its validity. If the ACK signal is "OK" then a data transfer according to the command is executed; otherwise, no data transfer occurs.

The communication protocol of the apparatus of FIG. 1 is summarized in the flow diagram of FIG. 4. For each of explanation, the term "Master" is employed to indicate the device which initiates a data transfer. The term "Slave" is employed to indicate the device which is addressed by the Master.

In step S1, the Master transmits an address of the Slave and a command to data bus 24. In step S2, the Slave receives the command and the Master and the Slave separately process the command in accordance with security key data obtained locally. The Master produces a KEYCMD signal as a function of the command and its security key. The Slave produces an ACK signal as a function of the received command and its security key.

In step S3, the Slave transmits an address of the Master and the ACK signal to data bus 24. In step S4, the Master receives the ACK signal and determines whether the ACK signal is equal to the KEYCMD signal. If the two signals are not equal, then processing follows step S5; otherwise, processing follows step S6. In step S5, the Master inhibits or simply does not execute a video data transfer between the Master and the Slave. In step S6, the Master executes a video data transfer by transmitting an address of the Slave and video data to the Slave, or by receiving and recognizing its own address and receiving video data transmitted by the Slave.

A second embodiment of the video data communication system according to the present invention is illustrated in FIG. 5. Such video data communications system is comprised of a receiver 25, a data bus 24, and one or more peripheral devices. The peripheral devices may transmit and/or receive control signals and/or video data through data bus 24. Two such peripheral devices are illustrated in FIG. 5, specifically, a recording/reproducing device 26 and a recording/reproducing device 27. Each of receiver 25, device 26, and device 27 is connected to data bus 24 and is capable of transmitting and receiving control signals and video data through data bus 24.

Receiver 25 is suited for receiving, descrambling, enciphering, deciphering, and decoding an input digital video signal. Specifically, receiver 25 is comprised of a tuner 30, a descrambler 31, a switch 32, an I/O port 33, a controller 134, a memory 35, a switch 36, an encipherer 38, a decipherer 39, and a decoder 37. Elements of FIG. 5 having the same structure and function as the corresponding elements of FIG. 1 are indicated by the same reference numeral used in FIG. 1. Tuner 30 is coupled to descrambler 31. Descrambler 31 descrambles, as needed, the selected digital video signal provided by tuner 30 and provides an unscrambled version of the digital video signal to encipherer 38.

Encipherer 38 is coupled to descrambler 31, controller 134, and switch 32. Utilizing an encryption key provided by controller 134, encipherer 38 encrypts the descrambled video signal provided by descrambler 31. The encrypted video signal is provided to switch 32.

Switch 32 is further connected to controller 134 and I/O port 33. Switch 36 is coupled to controller 134, decipherer 39 and I/O port 33. I/O port 33 is further connected to data bus 24 and to controller 134.

Decipherer 39 is coupled to controller 134 and decoder 37. Decipherer 39 receives an encryption key from controller 134 to decrypt video data provided from switch 36. Decipherer 39 supplies decrypted video data to decoder 37. Decoder 37 provides uncoded digital video signal data to a video display device (not shown).

Controller 134 is coupled to memory 35. In response to commands provided by a user, or according to a prestored set of instructions, controller 134 transmits to or receives from data bus 24, through I/O port 33, address, control and data signals. By manipulating switch signals provided to switches 32 and 36, controller 134 controls the flow of digital video data through I/O port 33. In an alternate embodiment (not shown), controller 134 directly controls the operation of I/O port 33 with I/O port control signals and monitors data flowing through I/O port 33.

Controller 134 additionally controls the encryption and decryption of video data by receiver 25. Controller 134 provides an encryption key to encipherer 38 for the encryption of descrambled video data. Similarly, controller 134 provides an encryption key to decipherer 39 to decrypt the video data supplied through switch 36. As detailed below, the encryption key is either retrieved from memory 35 or from data bus 24.

Recording/reproducing device 26 is comprised of an I/O port 40A, a switch 41A, a recording/reproducing section 42A, a switch 43A, a controller 144A, a card port 45A, a decipherer 46A, and an encipherer 47A. I/O port 40A is coupled to data bus 24, controller 144A, switch 41A, and

switch 43A. I/O port 40A routes address, control and data signals to and from data bus 24 and controller 144A. Switch 41A is further coupled to controller 144A and decipherer 46A. Switch 43A is further coupled to controller 144A and encipherer 47A. Controller 144A is coupled to card port 45A, decipherer 46A and encipherer 47A. Recording/reproducing section 42A is coupled to decipherer 46A and encipherer 47A.

Decipherer 46A receives an encryption key from controller 144A and encrypted video data from switch 41A. Decipherer 46A decrypts the encrypted data according to the encryption key and provides decrypted data to section 42A. Encipherer 47A receives an encryption key from controller 144A and video data from section 42A. Encipherer 47A encrypts the video data according to the encryption key and provides the encrypted video data to switch 43A.

In response to commands provided by a user or according to a prestored set of instructions, and in dependence upon signals supplied by card port 45A, controller 144A transmits to or receives from data bus 24, through I/O port 40A, address, control and data signals. By manipulating switch signals provided to switches 41A and 43A, controller 144A controls the flow of digital video data through I/O port 40A. In an alternate embodiment (not shown), controller 144A further directly controls the operation of I/O port 40A with I/O port control signals and monitors data flowing through I/O port 40A.

As illustrated, device 27 is substantially the same as device 26, like elements being denoted by like reference numerals with the exception of the terminating letter A and B. Key card 48, which is shown attached to card port 45B of device 27, stores a valid security key corresponding to a security key stored in memory 35.

Operation of the second embodiment of the video data communication system will be described below. One of the most important features of this second embodiment is that each signal, except video data signals, transmitted via data bus 24 is accompanied by an address signal corresponding to an address of a particular device. As in the first embodiment, each device attached to data bus 24 is assigned a particular address. Video data is transmitted to data bus 24 in an encrypted form but without an address. Each device connected to data bus 24 and capable of receiving data therefrom has access to encrypted data on data bus 24. However, only devices having a correct encryption key can decrypt the encrypted video data. In this manner, encrypted video data is provided to devices connected to data bus 24 but only devices having a correct encryption key can decrypt and utilize the video data. The encryption key may be stored in each decrypting device or provided by the device supplying the encrypted data.

This communication protocol allows for many different sequences of signal transfer between devices connected to data bus 24. Examples of these signal transfer sequences, implemented in different modes of operation of the present invention, will be described in detail below. In one mode of operation, broadcast digital video data signals are received by receiver 25, encrypted, and transmitted to data bus 24 for receipt by a peripheral device which decrypts the signals and displays, records, or otherwise processes the decrypted data. In another mode, prerecorded video data are reproduced, encrypted, and transmitted by a peripheral device to a decoding device for decryption, decoding, and subsequent display. In still another mode, prerecorded video data are reproduced, encrypted, and transmitted by one peripheral device to another peripheral device which decrypts and records the video data.

In a broadcast encrypt/decrypt display mode, receiver 25 receives a broadcast video signal and supplies the broadcast signal to a decryption display device (not shown in FIG. 5) connected to data bus 24. An example of such a decryption display device is illustrated in FIG. 11 and will be described in detail in a later section. Tuner 30 selectively receives a broadcast signal and provides the signal to descrambler 31. Descrambler 31 descrambles the broadcast video signal and provides a descrambled version of the signal to encipherer 38.

Controller 134 configures I/O port 33 to couple controller 134 with data bus 24 and then transmits an address of a particular display device along with a display command to data bus 24. The display device (not shown in FIG. 5) reads the address on data bus 24, recognizes the address as its own, and reads the accompanying display command from data bus 24. The display device processes the display command to generate an ACK signal and transmits an address of receiver 25 along with the ACK signal to data bus 24. The address and ACK signal supplied by the display device are received by controller 134 via I/O port 33.

Controller 134 retrieves a security key from memory 35 and generates a KEYCMD signal as a function of the display command and the retrieved security key. The KEYCMD signal is then compared to the received ACK signal. If the ACK signal is equal to the KEYCMD signal, then controller 134 transmits an address signal, corresponding to the selected display device, along with an encryption key, and appropriately manipulates I/O port 33 to route the address signal and the encryption key to data bus 24.

Controller 134 provides the encryption key to encipherer 38. Encipherer 38 encrypts the descrambled signal according to the encryption key and provides an encrypted signal to switch 32. Controller 134 also issues a switch command to switch 32, causing it to close, and an I/O port control signal to I/O port 33, causing it to couple switch 32 with data bus 24.

The encrypted video signal transmitted from encipherer 38 propagates through switch 32 and I/O port 33 to data bus 24. The address signal on data bus 24 is recognized by the display device and the subsequently transmitted encryption key is received and stored. Encrypted video signal is retrieved from data bus 24 and is decrypted according to the received encryption key, processed, and displayed. Other peripheral devices connected to data bus 24 rad the video data present on data bus 24, however, only a device which possesses a correct encryption key can decrypt the data.

In an alternate embodiment, the receiver does not transmit an address along the encryption key to the data bus and instead the encryption key is prestored in the display device. The encrypted data is still transmitted to data bus 24 without an address.

In an encrypt/decrypt recording mode of operation, receiver 25 receives a broadcast signal, encrypts the signal according to an encryption key, and transmits the key and the encrypted signal via data bus 24 to a particular peripheral device which records the signal. Specifically, controller 134 configures I/O port 33 to couple controller 134 with data bus 24 and then transmits an address of a particular recording device along with a record command to data bus 24. Assuming, for example, that the address transmitted corresponds to an address of device 26, controller 144A, through I/O port 40A, reads the address on data bus 24, recognizes the address as its own, and reads the accompanying record command from data bus 24. Controller 144A processes the record command to generate an ACK signal.

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Specifically, controller 144A polls card port 45A for a security key and generates an ACK signal as a function of the received record command and the signal returned by card port 45A. Controller 144A then transmits an address of receiver 25 and the ACK signal via I/O port 40A to data bus 24. The address and ACK signal supplied by device 26 is received by controller 134 via I/O port 33.

Controller 134 retrieves a security key from memory 35 and generates a KEYCMD signal as a function of the record command and the retrieved security key. The KEYCMD signal is then compared to the received ACK signal. If the ACK signal is equal to the KEYCMD signal, then controller 134 transmits an address signal of the particular recording device along with the encryption key to data bus 24 through I/O port 33 and configures switch 32 and I/O port 33 for the transmission of encrypted video data from encipherer 38 to data bus 24 to initiate the transfer of video data. If the ACK signal is not equal to the KEYCMD signal, then controller 134 issues a switch command signal, causing switch 32 to open, to prevent the flow of encrypted broadcast video data to data bus 24.

Since, as illustrated in FIG. 5, card port 45A of device 26 is not coupled to a card key containing a correct security key, controller 144A will, in that case, generate an ACK signal which is not equal to the KEYCMD signal produced by controller 134 and no video data transfer will occur. Thus, the supply of encrypted broadcast video data to a particular recording device depends upon the installation of an appropriate key card in the card port of the particular device.

When device 27 is selected to record broadcast video data, controller 134 outputs an address of device 27 along with a record command to data bus 24 through I/O port 33. Controller 144B, through I/O port 40B reads the address on data bus 24, recognizes the address signal as its own, and reads the accompanying record command. Controller 144B retrieves a security key from key card 48 via card port 45B. Controller 144B generates an ACK signal as a function of the received record command and the retrieved security key. Controller 144B transmits an address of receiver 25 and the ACK signal to data bus 24 through I/O port 40B.

As above, controller 134 reads the address signal and the ACK signal, generates a KEYCMD signal, and compares the ACK and KEYCMD signals. If the security key contained in key card 48 corresponds to the security key contained in memory 35, the ACK signal and the KEYCMD signal are equal. Meanwhile, controller 144B supplies a switch control signal to switch 41B, causing it to close, thereby connecting I/O port 40B with decipherer 46B. Further, I/O port 40B is configured to route video data from data bus 24 to decipherer 46B. After verifying that the two security keys correspond, controller 134 facilitates the transmission to device 27 of an address of device 27 along with an encryption key followed by encrypted video data without an address.

Controller 144B, through I/O port 40B, reads the address on data bus 24, recognizes the address as its own, and reads the accompanying encryption key from data bus 24. Controller 144B supplies the encryption key to decipherer 46B. Encrypted video data on data bus 24 is retrieved and passed through I/O port 40B and witch 41B to decipherer 46B for deciphering according to the retrieved encryption key. Decipherer 46B supplies decrypted video data to section 42B for recording. As a result, recording devices having the selected address and provided with a key card 48 having a correct security key retrieve, decrypt, and record encrypted video data supplied by receiver 25.

In a playback mode of operation, receiver 25 initiates the playback of prerecorded data from a peripheral device. Controller 134 transmits an address signal, corresponding to an address of a particular peripheral device, along with a playback command to data bus 24 through I/O port 33. Assuming, for example, that the address signal corresponds to an address of device 26, controller 144A, through I/O port 40A, reads the address on data bus 24, recognizes the address as its own, and reads the accompanying playback command from data bus 24. As described previously, controller 144A generates an ACK signal as a function of the playback command and a signal provided by card port 45A. Controller 144A then transmits an address of receiver 25 and this ACK signal via I/O port 40A to data bus 24. Controller 144A also issues a switch control signal to switch 43A, causing it to close and configures I/O port 40A to connect data bus 24 and switch 43A.

Controller 134, through I/O port 33, reads the address on data bus 24, recognizes the address as its own, and reads the accompanying ACK signal. Controller 134 retrieves a security key from memory 35 and generates a KEYCMD signal as a function of the playback command and the retrieved security key. The received ACK signal is compared to the KEYCMD signal and, if they are equal, controller 134 issues a switch control signal to switch 36, causing it to close, and issues an I/O port control signal to I/O port 33, causing it to route signals from data bus 24 to switch 36. However, if the ACK signal does not equal the KEYCMD signal, then controller 134 issues a switch control signal which causes switch 36 to open.

Since a key card having a correct security key is not installed in device 26, the ACK signal produced by device 26 will not be equivalent to the KEYCMD signal produced by controller 134. Even though recording/reproducing section 42A may output encrypted prerecorded video data to data bus 24 via switch 43A and I/O port 40A, the data will not reach decoder 37, since switch 36 will have been opened.

In the case where controller 134 initially issues an address corresponding to device 27, controller 144B reads and recognizes the address reads the accompanying playback command, and polls card port 45B. Key card 48, having a security key corresponding to that stored in memory 35, supplies the security key to controller 144B through card port 45B. Controller 144B generates an ACK signal as a function of the received playback command and the security key received from key card 48. The ACK signal and the address of receiver 25 are transmitted via data bus 24 to controller 134 and switch 43B is closed. Controller 134 reads and recognizes the address, reads the accompanying ACK signal, and generates a KEYCMD signal as a function of the playback command and a security key obtained from memory 35. In this instance, the ACK signal and the KEYCMD signal are equal, and accordingly, controller 134 causes witch 36 to close.

Controller 144B outputs an address of receiver 25 along with an encryption key to data bus 24. Recording/reproducing section 42B outputs a prerecorded video data signal to encipherer 47B which encrypts the signal according to the encryption key. Encipherer 47B outputs an encrypted data signal to data bus 24 via switch 43B and I/O port 40B.

Controller 134 reads and recognizes the address and retrieves the accompanying encryption key. Controller 134 provides the encryption key to decipherer 39. The encrypted video data signal is retrieved from data bus 24 and supplied through I/O port 33 and switch 36 to decipherer 39. Deci-

pherer 39 decrypts the encrypted signal according to the encryption key and supplies a decrypted video signal to decoder 37. Decoder 37 decodes the prerecorded video data signal and supplies the decoded signal to a video display (not shown). Receiver 25 thus decrypts and decodes video data reproduced by a peripheral device in which a key card having a correct security key is installed.

In each of the above modes, it is alternately contemplated that one or more of the I/O ports has a fixed and inflexible structure which prevents its manipulation by a connected controller. In each of the above modes, it is further alternately contemplated that an address and the encryption key are not transmitted prior to the transmission of encrypted video data, but rather that the encryption key is prestored in the device which retrieves the encrypted video data.

The signal processing and interchange of messages in receiver-initiated data transfers according to the embodiment of the invention shown in FIG. 5 are diagrammatically represented in FIGS. 6(a)–(d). In each of FIGS. 6(a)–(d), the time axis runs positive in the direction indicated by the arrow. Although not explicitly mentioned i the following discussion, it should be understood that each communication between devices, with the exception of encrypted video data, includes an address of the device to which the communication is being sent.

FIG. 6(a) illustrates the interaction between receiver 25 and device 26 of FIG. 5 when receiver 25 initiates video data recording. In FIG. 6(a) receiver 25 first issues a record command to device 26. Receiver 25 then processes the record command in conjunction with a security key retrieved from memory 35 to produce a KEYCMD signal. Device 26 receives the record command and similarly processes it in conjunction with a security key retrieved from card port 45A to produce an ACK signal. Device 26 then transmits the ACK signal to receiver 25. Receiver 25 compares the received ACK signal with the KEYCMD signal to determine if they are equal. Since a key card having a correct security key is not installed in device 26, the KEYCMD signal and the ACK signal are not equal. As a result, receiver 25 determines that the ACK signal is "no good" (NG) and no data is output by receiver 25.

In FIG. 6(b), receiver 25 transmits a record command to device 27. As in the manner previously described, both receiver 25 and device 27 process the recording command to produce, respectively, a KEYCMD signal and an ACK signal. Device 27 transmits the ACK signal to receiver 25. Receiver 25 compares the KEYCMD signal and the received ACK signal. Since device 27 is engaged with a key card having a correct security key, the ACK signal and the KEYCMD are equal. Receiver 25 determines that the ACK signal is thus "OK" and transmits an encryption key to device 27. Receiver 25 also sends encrypted video data to data bud 24. Device 27 retrieves, decrypts, and records the encrypted video data.

FIGS. 6(c) and 6(d) illustrate the sequence of steps which occur when receiver 25 issues a playback command to a peripheral device. In FIG. 6(c), receiver 25 transmits a playback command to device 26. Receiver 25 processes the playback command in conjunction with a security key retrieved from memory 35 to produce a KEYCMD signal. Device 26 processes the received playback command in conjunction with a security key retrieved from card port 45A to produce an ACK signal. Device 26 transmits the ACK signal to receiver 25. Receiver 25 compares the KEYCMD signal with the received ACK signal to determine if they are equal. Since a key card containing a correct security key is not installed in device 26, the ACK signal is not equal to the KEYCMD signal. Accordingly, receiver 25 determines that the ACK signal is "no good" (NG). Nonetheless, device 26 attempts to send an encryption key and encrypted reproduced video signal data to receiver 25 via data bus 24, but receiver 25 does not retrieve the key and the video data.

In FIG. 6(d), receiver 25 transmits a playback command to device 27. Receiver 25 process the playback command, as before, to produce a KEYCMD signal. Device 27 processes the received playback command in conjunction with a security key retrieved from card port 45B to produce an ACK signal. Device 27 transmits this ACK signal to receiver 25. Receiver 25 compares the KEYCMD signal to the received ACK signal to determine if they are equal. Since key card 48 is engaged in device 27 and key card 48 contains a valid security key, the ACK signal and the KEYCMD signal are equal. Accordingly, receiver 25 determines that the ACK signal is "OK". Device 27 reproduces a prerecorded video signal and transmits an encryption key and encrypted reproduced video data to receiver 25. Receiver 25 accepts the encryption key and retrieves the encrypted video data.

The signal processing and interchange of messaging in device-initiated data transfer according to the second embodiment of the invention are diagrammatically represented in FIGS. 7(a)–(d). In each of FIGS. 7(a)–(d), the time axis runs positive in the direction indicated by the arrow. Although not explicitly mentioned in the following discussion, it should be understood that each communication between devices, with the exception of encrypted video data, includes an address of the device to which the communication is being sent.

FIGS. 7(a) and 7(c) illustrate the interaction between device 26 and receiver 25 of FIG. 1 when device 26 initiates the transfer of video data. In FIG. 7(a), device 26 first issues a send data command to receiver 25. Device 26 then processes the send data command in conjunction with a security key retrieved from card port 45A to produced a KEYCMD signal. Receiver 25 receives the send data command and similarly process it in conjunction with a security key retrieved from memory 35 to produce an ACK signal. Receiver 25 then transmits the ACK signal to device 26. Device 26 compares the received ACK signal with the KEYCMD signal to determine if they are equal. Since a key card having a correct security key is not installed in device 26, the KEYCMD signal and the ACK signal are not equal. As a result, device 26 determines that the ACK signal is "no good" (NG). Nonetheless, receiver 25 attempts to transmit an encryption key and encrypted broadcast video data to device 26 via data bus 24, but device 26 does not retrieve the encryption key nor the video data.

In FIG. 7(c), device 26 first transmits a receive data command to receiver 25. Device 26 then processes the receive data command in conjunction with a security key retrieved from card port 45A to produce a KEYCMD signal. Receiver 25 receives the receive data command and similarly processes it in conjunction with a security key retrieved from memory 35 to produce an ACK signal. Receiver 25 then transmits the ACK signal to device 26. Device 26 compares the received ACK signal with the KEYCMD signal to determine if they are equal. Since a key card having a correct security key is not installed in device 26, the KEYCMD signal and the ACK signal are not equal. As a result, device 26 determines that the ACK signal is "no good" (NG) and no data is output by device 26.

Each of FIGS. 7(b) and 7(d) illustrates the sequence of operations that occur when device 27 issues a command to

receiver 25. In FIG. 7(b), device 27 first transmits a send data command to receiver 25. Device 27 processes the send data command in conjunction with a security key retrieved from card port 45B to produce a KEYCMD signal. Receiver 25 processes the send data command in conjunction with a security key retrieved from memory 35 to produce an ACK signal. Receiver 25 then transmits the ACK signal to device 27. Device 27 compares the KEYCMD signal with the received ACK signal to determine if they are equal. Since key card 48 is engaged in device 27 and key card 48 contains a correct security key, the ACK signal and the KEYCMD signal are equal. Accordingly, device 27 determines that the ACK signal is "OK". Receiver 25 transmits an encryption key and encrypted video data to device 27 which decrypts and records the video data.

In FIG. 7(d), device 27 first transmits a receive data command to receiver 25. Device 27 processes the receive data command in conjunction with a security key retrieved from card port 45B to produce a KEYCMD signal. Receiver 25 processes the receive data command in conjunction with a security key retrieved from memory 35 to produce an ACK signal. Receiver 25 transmits the ACK signal to device 27. Device 27 compares the KEYCMD signal with the received AKC signal to determine if they are equal. Since key card 48 is engaged in device 27 and key card 48 contains a correct security key, the ACK signal and the KEYCMD signal are equal. Accordingly, device 27 determines that the ACK signal is "OK". Device 27 reproduces and encrypts a pre-recorded video signal and transmits the encryption key and the encrypted reproduced video data to receiver 25. Receiver 25 accepts, decrypts, and further processes the video data as described above.

In an encrypt/decrypt dubbing mode, encrypted data is communicated between two peripheral devices, such as the devices 26 and 27, each installed with a key card having the same security key. A master of such peripheral devices initiates a video data transfer by transmitting to data bus 24 an address of a slave among the peripheral devices along with a record command or a playback command. As described in the preceding, the slave device reads and recognizes the address, configures itself according to the command, and returns an address and an ACK signal.

As also described in the preceding, the master device reads and recognizes the address and processes the ACK signal to determine its validity. If the ACK signal is "OK" then a data transfer according to the command is executed; otherwise, no data transfer occurs. As part of a data transfer, the transmitting device reproduces and encrypts, according to an encryption key, prerecorded data. The encryption key is sent with the address of the receiving peripheral device to data bus 24. The other receiving peripheral device reads and recognizes the address and retrieves the encryption key. The transmitting device sends the encrypted data to data bus 24 and the receiving device retrieves, decrypts, and records the encrypted data.

The communication protocol of the apparatus of FIG. 5 is summarized in the flow diagram of FIG. 8. For ease of explanation, the term "Master" is employed to indicate the device which initiates a data transfer. The term "Slave" is employed to indicate the device which is addressed by the Master.

In step S7, the Master transmits an address of the Slave and a command to data bus 24. In step S8, the Slave receives the command and the Master and the Slave separately process the command in accordance with security key data obtained locally. The Master device produces a KEYCMD signal as a function of the command and its security key. The Slave produces an ACK signal as a function of the received command and its security key.

In step S9, the Slave transmits an address of the Master and the ACK signal to data bus 24. In step S10, the Master receives the ACK signal and determines whether the ACK signal is equal to the KEYCMD signal. If the two signals are not equal, then processing follows step S11; otherwise, processing follows step S12. In step S11, the Master inhibits or simply does not execute a video data transfer between the Master and the Slave. In step S12, the Master executes a video data transfer by transmitting an encryption key and encrypted video data to the Slave, or by receiving and retrieving an encryption key and encrypted video data transmitted by the Slave.

FIG. 9 illustrates a display device 28-1 suitable for connection to data bus 24 of the first embodiment of the invention described above with reference to FIG. 1. Display device 28-1 is comprised of a cathode-ray tube (CRT) 60, a signal processor 59, a decoder 58, a descrambler 57, a memory 56, a controller 55A, a switch 54, a descrambler 57, a memory 56, a controller 55A, a switch 54, a tuner 53, a digital tuner 52, a switch 51, and an I/O port 50, CRT 60 and signal processor 59 are conventional devices which together comprise a conventional display apparatus. Tuner 53 is a conventional broadcast tuner which receives an unscrambled video signal. Tuner 52 is a satellite digital signal tuner which receives scrambled video data signals. Tuner 53, tuner 52 and switch 51 are coupled to inputs of switch 54 and each provides a respective video signal thereto.

I/O port 50 is coupled to data bus 24 (not shown), switch 51, and controller 55A. I/O port 50 routes data signals to switch 51 and routes address, control and data signals to controller 55A. Controller 55A is further coupled to switch 51, memory 56, switch 54, descrambler 57 and decoder 58. Memory 56 stores one or more security keys which controller 55A retrieves as needed. Controller 55A controls the state of switches 54 and 51 with switch control signals. Controller 55A can also enable or disable the operations of decoder 58 and descrambler 57.

Descrambler 57 is further coupled to the output of switch 54 and the input of decoder 58. When enabled by controller 55A, descrambler 57 descrambles video data and supplies unscrambled video data to decoder 58. When disabled by controller 55A, descrambler 57 passes video signals from switch 54 to decoder 58.

Decoder 58 is further coupled to the input of signal processor 59. When enabled by controller 55A, decoder 58 decodes video data and supplies decoded video data to signal processor 59. When disabled by controller 55A, decoder 58 passes video signals from descrambler 57 to signal processor 59.

Display device 28-1 has three modes of operation. In the first mode, controller 55A causes switch 54 to link tuner 53 with descrambler 57. Controller 55A disables descrambler 57 and decoder 58, allowing signal processor 59 and CRT 60 to display ordinary video data received by tuner 53.

In the second mode, controller 55A causes switch 54 to link tuner 52 with descrambler 57. Controller 57 enables descrambler 57 and decoder 58. Descrambler 57 descrambles a scrambled and coded video signal supplied by tuner 52 and supplies an unscrambled, though still coded, video signal to decoder 58. Decoder 58 decodes the coded signal and provides an uncoded video signal to signal processor 59 for display.

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In the third mode, controller **55A** reads an address signal on data bus **24** through I/O port **50**. If the address corresponds to an address previously assigned to device **28-1**, then controller **55A** recognizes the address as such and processing proceeds as follows. Controller **55A** retrieves a display command from data bus **24**. Controller **55A** generates an ACK signal as a function of the display command and a security key retrieved from memory **56**. Controller transmits an address of the device which sent the display command along with the ACK signal to data bus **24** through I/O port **50**. Controller **55A** also causes switch **51** to close, connecting I/O port **50** with switch **54**, and causes switch **54** to connect switch **51** with descrambler **57**. Controller **55A** also enables descrambler **57** and decoder **58**.

Controller **55A** monitors data bus **24** for another address signal corresponding to device **28**-a. Upon receipt of such an address, video data is then retrieved from data bus **24** and supplied through I/O port **50**, switch **51**, and switch **54** to descrambler **57**. Descrambler **57** descrambles, as needed, the retrieved video data and provides an unscrambled video signal to decoder **58**. Decoder **58** decodes the signal and supplies an uncoded video signal to signal processor **59** for display on CRT **60**.

FIG. **10** illustrates a decoding device **29-1** suitable for connection to data bus **24** of the first embodiment of the invention in place of the receiver **21**. Decoding device **29-1** is comprised of a memory **72**, a controller **71A**, an I/O port **70**, a switch **73**, and a decoder **74**. Decoder **74** and switch **73** have the same structure and function as their counterparts decoder **37** and switch **36** of receiver **21**. Controller **71A** is coupled to memory **72**, I/O port **70**, and switch **73**. Switch **73** is further connected to decoder **74** and I/O port **70**. I/O port **70** is further coupled to data bus **24**.

As in the processing described above, controller **71A** monitors data bus **24** for an address signal of device **29-1**. Upon recognizing such an address signal, controller **71A** retrieves a display command from data bus **24** and generates an ACK signal as a function of the display command and a security key retrieved from memory **72**. The ACK signal is transmitted with the appropriate address to data bus **24**. Video data accompanied by an address of device **29-1** is retrieved and routed through I/O port **70** and switch **73** to decoder **74**. Decoder **74** decodes the video signal and provides an uncoded video signal to a display (not shown).

As earlier noted, FIG. **11** illustrates a display device **28-2** suitable for connection to data bus **24** of the second embodiment of the invention. Display device **28-2** is comprised of the elements described above in connection with the display device **28-1**, and which are interconnected and function in the same manner as in display device **28-1** except as described in the following. Unlike display device **28-1**, display device **28-2** includes a decipherer **61** interposed between switch **51** and switch **54** and controller **55A** is replaced by controller **55B**. Controller **55B** is additionally coupled to decipherer **61** and supplies an encryption key thereto. Decipherer **61** decrypts encrypted video data supplied from switch **51** and supplies decrypted video data to switch **54**.

In accordance with the protocol of the second embodiment, controller **55B** monitors data bus **24** for an address of device **28-2** and an accompanying display command. An ACK signal is generated as a function of the retrieved display command a security key retrieved from memory **56**. Controller **55B** then transmits an appropriate address and the ACK signal to data bus **24**. Controller **55B** monitors data bus **24** for the address of device **28-2** and an accompanying encryption key. Upon receipt, decipherer **51** is supplied with the encryption key, and I/O port **50** and switch **51** are configured to route encrypted data through to decipherer **61**. Decipherer **61** decrypts the video data and supplies a decrypted signal suitable for subsequent processing as described with respect to device **28-1**.

FIG. **12** illustrates a decoding device **29-2** suitable for connection to data bus **24** in place of the receiver **25** in the second embodiment of the invention. Decoding device **29-2** is comprised of the same elements as decoding device **29-1**, and such elements are interconnected and function in the same manner as in decoding device **29-1** except as described in the following. Unlike decoding device **29-1**, decoding device **29-2** includes a decipherer **76** interposed between switch **73** and decoder **74**, and controller **71A** is replaced by controller **71B**. Controller **71B** is additionally coupled to decipherer **76** and supplies an encryption key thereto. Decipherer **76** decrypts encrypted video data supplied from switch **73** and supplies decrypted video data to decoder **74**.

As described in the process above, controller **71B** monitors data bus **24** for an address signal of device **29-2**. Upon recognizing such an address signal, controller **71B** retrieves a display command from data bus **24** and generates an ACK signal as a function of the display command and a security key retrieved from memory **72**. The ACK signal is transmitted with the appropriate address to data bus **24**. An encryption key accompanied by an address of device **29-2** is retrieved by controller **71B** from data bus **24**. Encrypted video data supplied from data bus **24** is routed through I/O port **70** and switch **73** to decipherer **76**. Decipherer **76** decrypts the encrypted video data and provides a decrypted video signal to decoder **74**. Decoder **74** decodes the decrypted video signal and provides an uncoded video signal to a display (not shown).

Although illustrative embodiments of the present invention and modifications thereof have been described in detail herein, it is to be understood that this invention is not limited to these precise embodiments and modifications, and that other modifications and variations may be effected therein by one skilled in the art without departing from the scope and spirit of the invention as defined by the appended claims.

What is claimed is:

1. A method for communicating video data via a data bus between a master device and a slave device which are each coupled to said bus, comprising the steps of:

transmitting from said master device to said data bus a slave address of said slave device and a command;

generating, at said master device, a KEYCMD signal as a function of said command and a master security key;

receiving, at said slave device from said data bus, said slave address and said command and recognizing said slave address as corresponding to said slave device;

generating, at said slave device, an ACK signal as a function of said command and a slave security key;

transmitting from said slave device to said data bus a master address of said master device and said ACK signal;

receiving, at said master device from said data bus, said master address and said ACK signal and recognizing said master address as corresponding to said master device;

comparing said KEYCMD signal generated by said master device with said ACK signal received by said master device; and

executing a data transfer between said master device and said slave device if said KEYCMD signal corresponds to said ACK signal.

2. The method, according to claim 1, further comprising the step of:

inhibiting a data transfer between said master device and said slave device if said KEYCMD signal does not correspond to said ACK signal.

3. The method, according to claim 2, wherein said data is unencrypted and encoded and wherein said step of inhibiting a data transfer comprises:

transmitting said data from said slave device to said data bus; and

preventing said master device from decoding said data from said data bus.

4. The method, according to claim 2, wherein said step of inhibiting a data transfer comprises:

preventing said master device from transmitting said data to said data bus.

5. The method, according to claim 1, wherein said master device is a receiver and said slave device is a peripheral device.

6. The method, according to claim 5, wherein said peripheral device is a display device.

7. The method, according to claim 1, wherein said master device is a peripheral device and said slave device is a receiver.

8. The method, according to claim 1, wherein said master device is a first peripheral device and said slave device is a second peripheral device.

9. The method, according to claim 1, wherein said slave device comprises means for decoding an unencrypted coded data.

10. The method, according to claim 1, wherein said step of executing a data transfer comprises:

encrypting said data in said master device according to an encryption key; and

decrypting said data in said slave device according to said encryption key.

11. The method, according to claim 10, wherein said step of executing a data transfer further comprises:

transmitting said slave address and said encryption key from said master device to said data bus; and

receiving said encryption key and said slave address at said slave device from said data bus and recognizing said slave address as corresponding to said slave device.

12. The method, according to claim 10, further comprising the step of:

inhibiting a data transfer between said master device and said slave device if said KEYCMD signal does not correspond to said ACK signal.

13. The method, according to claim 12, wherein said step of inhibiting a data transfer comprises:

preventing said master device from transmitting said data to said data bus.

14. The method, according to claim 10, wherein said master device is a receiver and said slave device is a peripheral device.

15. The method, according to claim 14, wherein said peripheral device is a display device.

16. The method, according to claim 10, wherein said master device is a peripheral device and said slave device is a receiver.

17. The method, according to claim 10, wherein said master device is a first peripheral device and said slave device is a second peripheral device.

18. The method, according to claim 10, wherein said slave device comprises means for decoding a decrypted coded data.

19. The method, according to claim 1, wherein said step of executing a data transfer comprises:

encrypting said data in said slave device according to an encryption key; and

decrypting said data in said master device according to said encryption key.

20. The method, according to claim 19, wherein said step of executing a data transfer further comprises:

transmitting said master address and said encryption key from said slave device to said data bus; and

receiving said master address and said encryption key from said data bus at said master device and recognizing said master address as corresponding to said master device.

21. The method, according to claim 19, further comprising the step of:

inhibiting a data transfer between said master device and said slave device if said KEYCMD signal does not correspond to said ACK signal.

22. The method, according to claim 21, wherein said data is encrypted and encoded and wherein said step of inhibiting a data transfer comprises:

transmitting said data from said slave device to said data bus; and

preventing said master device from decoding said data from said data bus.

23. The method, according to claim 19, wherein said master device is a receiver and said slave device is a peripheral device.

24. The method, according to claim 23, wherein said peripheral device is a display device.

25. The method, according to claim 19, wherein said master device is a peripheral device and said slave device is a receiver.

26. The method, according to claim 19, wherein said master device is a first peripheral device and said slave device is a second peripheral device.

27. The method, according to claim 19, wherein said slave device comprises means for decoding a decrypted coded data.

28. A system for communicating video data comprising:

at least one master device having a master address;

at least one slave device having a slave address;

a data bus, coupled to said master device and to said slave device;

said master device including:

means for transmitting to said data bus said slave address and a command,

means for generating a KEYCMD signal as a function of said command and a master security key,

means for receiving from said data bus said master address and an ACK signal,

means for recognizing said master address as corresponding to said master device,

means for comparing said KEYCMD signal and said ACK signal, and

means for receiving said video data from said data bus if said KEYCMD signal corresponds to said ACK signal; and

said slave device including:

means for receiving from said data bus said slave address and said command,

means for recognizing said slave address as corresponding to said slave device,

means for generating said ACK signal as a function of said command and a slave security key, and

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means for transmitting to said data bus said master address, said ACK signal, and said video data.

29. The system according to claim 28, wherein said master device further comprises means for inhibiting reception of said video data from said data bus if said KEYCMD signal does not correspond to said ACK signal.

30. The system according to claim 29, wherein said means for inhibiting includes a switch.

31. The system according to claim 28, wherein said master device is a receiver and said slave device is a peripheral device.

32. The system according to claim 28, wherein said master device is a peripheral device and said slave device is a receiver.

33. The system according to claim 28, wherein said master device is a first peripheral device and said slave device is a second peripheral device.

34. The system according to claim 28, wherein said video data is unencrypted and encoded and wherein said slave device comprises means for decoding said video data.

35. The system according to claim 28, wherein:

said master device further includes means for decrypting said video data according to an encryption key; and

said slave device further includes means for encrypting said video data according to said encryption key.

36. The system according to claim 35, wherein:

said master device further includes means for receiving said encryption key from said data bus; and

said slave device further includes means for transmitting said encryption key to said data bus.

37. A system for communicating video data comprising:

at least one master device having a master address;

at least one slave device having a slave address;

a data bus, coupled to said master device and to said slave device;

said master device including:

means for transmitting to said data bus said slave address and a command,

means for generating a KEYCMD signal as a function of said command and a master security key,

means for receiving from said data bus said master address and an ACK signal,

means for recognizing said master address as corresponding to said master device,

means for comparing said KEYCMD signal and said ACK signal, and

means for transmitting to said data bus said video data if said KEYCMD signal corresponds to said ACK signal; and

said slave device including:

means for receiving from said data bus said slave address, said command and said video data,

means for recognizing said slave address as corresponding to said slave device,

means for generating said ACK signal as a function of said command and a slave security key, and

means for transmitting to said data bus said master address and said ACK signal.

38. The system according to claim 37, wherein said master device further includes means for inhibiting transmission of said video data to said data bus if said KEYCMD signal does not correspond to said ACK signal.

39. The system according to claim 37, wherein:

said master device further includes means for encrypting said video data according to an encryption key; and

said slave device further includes means for decrypting said video data according to said encryption key.

40. The system according to claim 39, wherein:

said master device further includes means for transmitting said encryption key to said data bus; and

said slave device further includes means for receiving said encryption key from said data bus.

41. A method for communicating data via a data bus between a master device and a slave device which are each coupled to the bus, comprising the steps of:

transmitting from said master device to said slave device an authentication inquiry via said bus;

transmitting from said slave device to said master device via said bus an authentication response to said authentication inquiry; and

executing a data transfer between said master device and said slave device via said bus if said authentication response is proper, said data transfer including the steps of:

encrypting data in said master device according to an encryption key; and

decrypting said data after being received by said slave device according to said encryption key.

42. The method of claim 41, further comprising the step of transmitting said encryption key from said master device to said slave device via said data bus.

43. The method of claim 41, further comprising the steps of:

transmitting a slave address and said encryption key from said master device to said data bus; and

receiving said encryption key and said slave address at said slave device from said data bus and recognizing said slave address as corresponding to said slave device.

44. The method of claim 41, further comprising the step of inhibiting data transfer between said master device and said slave device if said authentication response is not proper.

45. The method of claim 44, wherein the step of inhibiting data transfer comprises preventing said master device from transmitting data to said data bus.

46. A method for communicating data via a data bus between a master device and a slave device which are each coupled to the bus, comprising the steps of:

transmitting from said master device to said slave device an authentication inquiry via said bus;

transmitting from said slave device to said master device via said bus an authentication response to said authentication inquiry; and

executing a data transfer between said master device and said slave device via said bus if said authentication response is proper, said data transfer including the steps of:

encrypting data in said slave device according to an encryption key; and

decrypting said data after being received by said master device according to said encryption key.

47. The method of claim 46, further comprising the step of transmitting said encryption key from said slave device to said master device via said data bus.

48. The method of claim 46, further comprising the steps of:

transmitting a master address and said encryption key from said slave device to said data bus; and

receiving said encryption key and said master address at said master device from said data bus and recognizing said master address as corresponding to said master device.

49. The method of claim 46, further comprising the step of inhibiting data transfer between said master device and said slave device if said authentication response is not proper.

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50. The method of claim 49, wherein said step of inhibiting data transfer comprises:

transmitting said data from said slave device to said bus; and

preventing said master device from receiving said data from said data bus.

51. An apparatus for receiving a scrambled signal, comprising:

an input for receiving said scrambled signal;

a descrambler for descrambling said received signal;

an encryptor for encrypting said descrambled signal; and

a controller for executing an authentication procedure between said apparatus and a storage device via a data bus;

wherein said controller executes a data transfer of said encrypted signal to said storage device via said data bus if said authentication procedure is successfully executed.

52. The apparatus of claim 51, wherein said controller transfers an encryption key, via said data bus to said storage device, that is used by said encryptor.

53. The apparatus of claim 51, wherein said controller transfers an address information associated with said storage device and an encryption key, that is used in said encryptor, to said storage device via said data bus.

54. The apparatus of claim 51, further comprising:

a decoder for decoding said descrambled signal; and

a decryptor for decrypting a signal which is reproduced and transmitted from said storage device, wherein said controller executes a data transfer of said reproduced signal to said decoder via said data bus if said authentication procedure is successfully executed.

55. An apparatus for recording a signal on a recording medium, comprising:

a communication interface coupled to a data bus for receiving an encrypted signal from another device connected to said data bus;

a decryptor for decrypting said received signal;

a recording circuit for recording said decrypted signal on said recording medium;

a controller for executing via said data bus an authentication procedure between said apparatus and said other device, and for controlling said decryptor and said recording circuit;

wherein said controller initiates said decrypting and said recording of said received signal if said authentication procedure is successfully executed.

56. The apparatus of claim 55, further comprising:

a reproducing circuit for reproducing said recorded signal; and

an encryptor for encrypting said reproduced signal, wherein said controller executes said reproducing and encryption of said recorded signal if said authentication procedure is successfully executed, and the encrypted signal is transferred via said data bus to said other device connected to said data bus.

57. The apparatus of claim 56, wherein said controller transfers an encryption key via said data bus, which is used in said encryptor, to said other device connected to said data bus.

58. The apparatus of claim 55, wherein said controller receives an encryption key via said data bus which is used in said other device connected to said data bus.

59. An apparatus for reproducing a signal recorded on a recording medium, comprising:

a reproducing circuit for reproducing said signal recorded on said recording medium;

an encryptor for encrypting said reproduced signal;

a communication interface coupled to a data bus for transmitting said encrypted signal;

a controller for executing an authentication procedure via said data bus between said apparatus and another device connected to said data bus, and for controlling said reproducing circuit and encryptor;

wherein said controller executes said reproducing and encrypting of said recorded signal if said authentication procedure is successfully executed.

60. The apparatus of claim 59, wherein said controller transfers an encryption key via said data bus, which is used in said encryptor, to said other device connected to said data bus.

61. A method for communicating data via a data bus between a first and a second device which are coupled together via said data bus, comprising the steps of:

executing an authentication procedure between said first and second device;

encrypting said data at said first device when said authentication procedure is successfully executed;

transmitting said encrypted data from said first device to said second device via said data bus;

receiving said encrypted data at said second device; and

decrypting said encrypted data at said second device.

62. The method of claim 61, further comprising the step of transmitting an encryption key which is used in said encrypting step, via said data bus, from said first device to said second device.

63. The method of claim 61, further comprising the steps of:

transmitting an address information of said second device and an encryption key, which is used in said encrypting step, from said first device to said second device via said data bus; and

receiving said encryption key and said address information at said second device and recognizing, at said second device, said address information as corresponding to said second device.

64. The method of claim 61, further comprising the step of inhibiting data transfer between said first device and said second device if said authentication procedure is not successfully executed.

65. A method for communicating data via a data bus between a first and a second device which are coupled together via said data bus, comprising the steps of:

executing an authentication procedure between said first and second device;

transmitting encrypted data from said first device to said second device via said data bus when said authentication procedure is successfully executed;

transmitting an encryption key which is used to encrypt said data, from said first device to said second device via said data bus.

66. A method for communicating data via a data bus between a first and a second device which are coupled together via said data bus, comprising the steps of:

executing an authentication procedure between said first and second device;

receiving at said first device encrypted data transmitted from said second device via said data bus when said authentication procedure is successfully executed;

receiving at said first device an encryption key which is used to encrypt said data, from said second device via said data bus.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

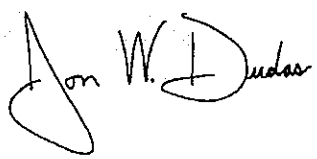
PATENT NO. : RE 38,055 E
DATED : April 1, 2003
INVENTOR(S) : Junichi Tsukamoto et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1,
Line 8, before subtitle "BACKGROUND OF THE INVENTION" insert -- Notice: More than one reissue application has been filed for the reissue of patent 5,699,426. The reissue applications are 09/461,136 and 10/323,357. --

Signed and Sealed this

Twenty-second Day of March, 2005



JON W. DUDAS
Director of the United States Patent and Trademark Office

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : RE 38,055 E
APPLICATION NO. : 09/461136
DATED : April 1, 2003
INVENTOR(S) : Junichi Tsukamoto et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1

Line 7, insert : (*) Notice: More than one reissue application has been filed for the reissue of patent no. 5,699,426. The reissue applications are 10/323,357 and 11/288,023.

Signed and Sealed this

Fourth Day of March, 2008

JON W. DUDAS
Director of the United States Patent and Trademark Office

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EXHIBIT H

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US00RE40468E

(19) **United States**
(12) **Reissued Patent**
Tsukamoto et al.

(10) **Patent Number: US RE40,468 E**
(45) **Date of Reissued Patent: Aug. 26, 2008**

(54) **VIDEO DATA BUS COMMUNICATION SYSTEM AND METHOD**

(75) Inventors: **Junichi Tsukamoto**, Tokyo (JP); **Koichi Goto**, Kanagawa (JP); **Shinichi Fukushima**, Kanagawa (JP)

(73) Assignee: **Sony Corporation**, Tokyo (JP)

(21) Appl. No.: **11/288,023**

(22) Filed: **Nov. 28, 2005**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **5,699,426**
Issued: **Dec. 16, 1997**
Appl. No.: **08/448,254**
Filed: **May 23, 1995**

U.S. Applications:

(63) Continuation of application No. 10/323,357, filed on Dec. 19, 2002, now Pat. No. Re. 38,898, which is a continuation of application No. 09/461,136, filed on Dec. 14, 1999, now Pat. No. Re. 38,055.

(30) **Foreign Application Priority Data**

May 24, 1994 (JP) 6-133813

(51) **Int. Cl.**
H04N 7/167 (2006.01)
H04L 9/00 (2006.01)

(52) **U.S. Cl.** **380/240**; 380/242; 348/E5.004; 348/E5.108; 348/E7.056; 386/E5.002; 375/E7.017; 375/E7.019

(58) **Field of Classification Search** 348/E5.004, 348/E5.108, E7.056; 386/E5.002; 375/E7.017, 375/E7.019; 380/200, 210–242, 255, 268, 380/277–286, 30
See application file for complete search history.

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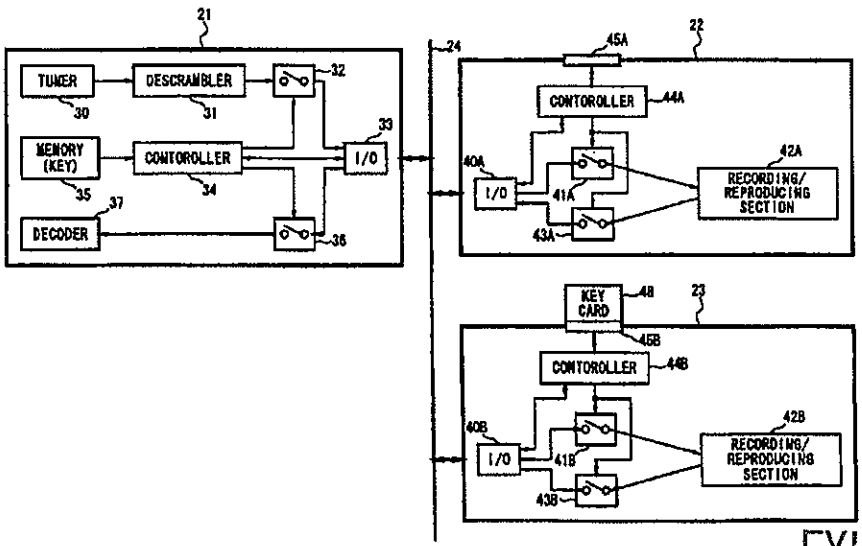
Primary Examiner—Bernarr E. Gregory
(74) *Attorney, Agent, or Firm*—Frommer Lawrence & Haug LLP; William S. Frommer

(57) **ABSTRACT**

A video data communication system and method are disclosed which provides for the secure transmission of video data among devices connected to a video data bus. The video data is transmitted with address information corresponding to a particular device or, alternatively, video data is encrypted and transmitted on the data bus without address information.

5 Claims, 10 Drawing Sheets



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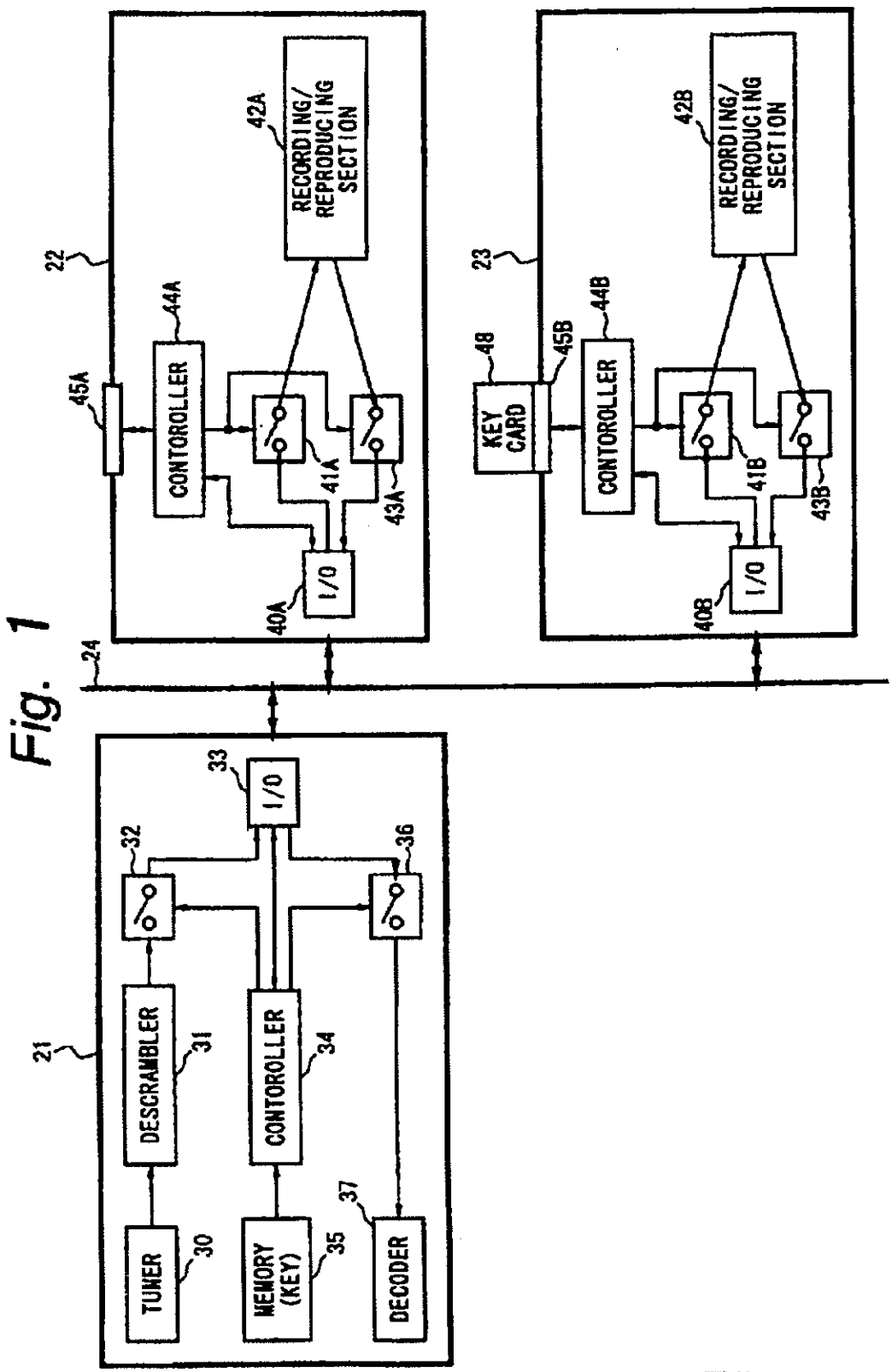

Fig. 1

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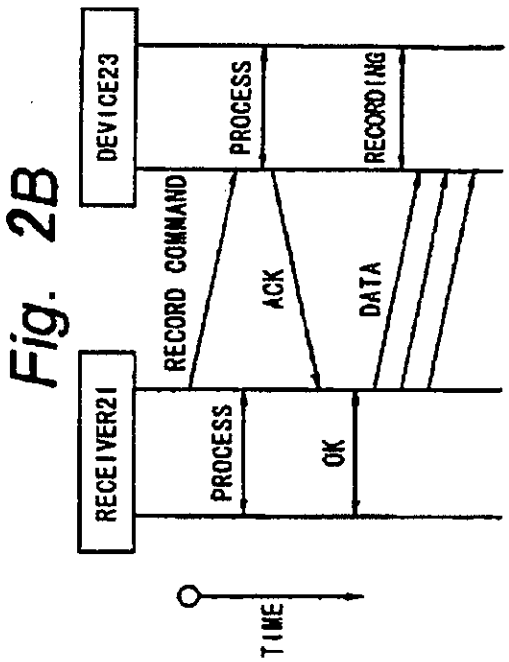

Fig. 2B

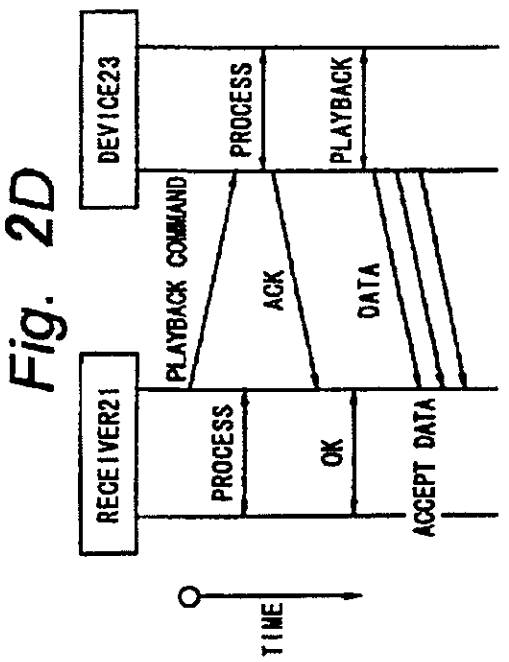

Fig. 2D

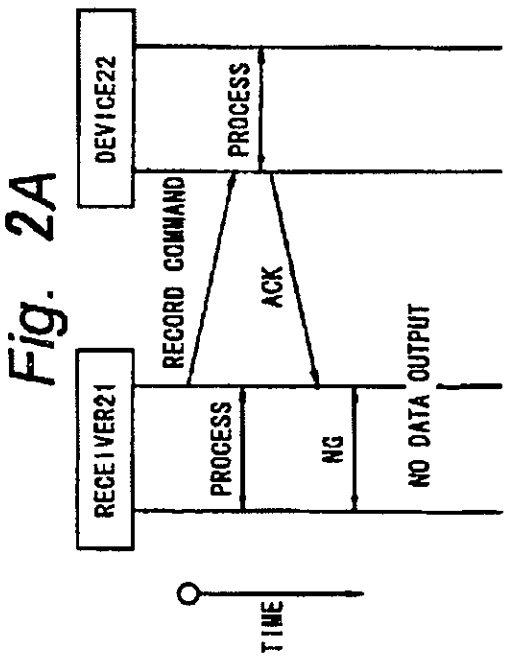

Fig. 2A

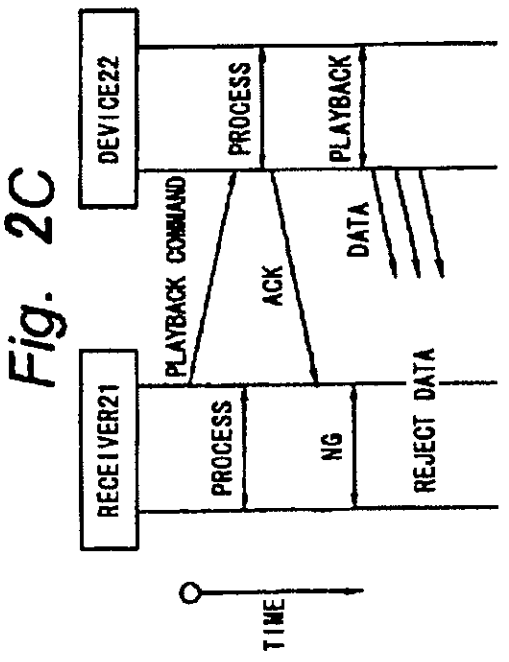

Fig. 2C

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